FACTORY
MANAGEMENT and MAINTENANCE

April, 1935

L. C. MORROW
Editor

1935 IS BUILDING MAINTENANCE YEAR

RUST and deterioration go on unceasingly through good times and bad. They obey no codes of fair practice, no limitation of hours. Unless prevented they lead straight to destruction of indispensable property—in short, plant buildings.

Industry has seriously neglected its buildings during the past few years. There may have been excuses aplenty, but the neglect has been costly nevertheless. Payment for maintenance and rehabilitation has been deferred, and the size of the bill has been increased tremendously by the waiting.

Here is proof that it costs less to keep buildings in good condition than to neglect them. A manufacturer erected a million-dollar building sixteen years ago. There followed a long period of neglect due to unwillingness to spend any money on maintenance. Right now this manufacturer is spending $50,000 for new sash and similar replacements. A responsible construction firm tells us that if a third of this sum had been spent on upkeep the present large outlay could have been avoided.

In another plant nothing was done to the steel sash for the past eight years. Now 50,000 square feet of sash is being replaced at a cost of $35,000. It is estimated that $7,000 spent in painting and maintenance during those eight years would have made the present expenditure unnecessary. An investment of $7,000 in maintenance would have earned just 400 per cent in this instance.

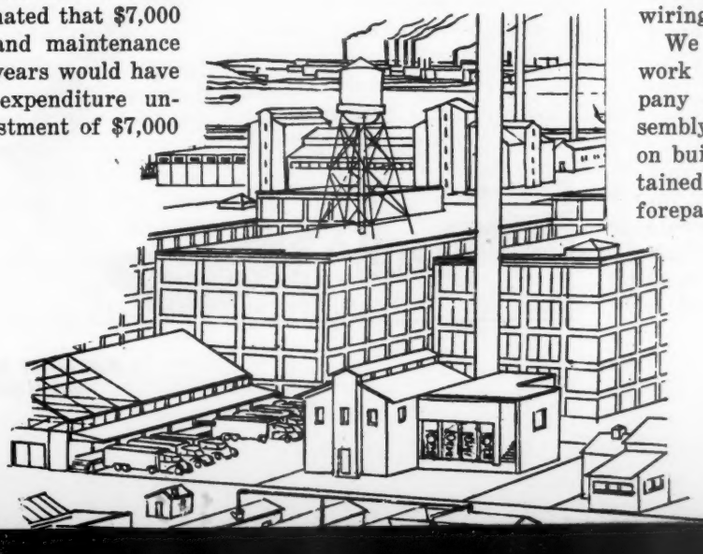
A third plant shortly will be handed a bill for $150,000, covering the cost of replacing 200,000 square feet of exterior wall surface that was allowed to deteriorate beyond repair. Spending $25,000 in proper maintenance over a period of 15 years would have made most of this huge outlay unnecessary.

While deterioration is tearing down a building, obsolescence is destroying its value. Buildings of all kinds become out of date, both in appearance and facilities. New types of materials and equipment, improvements in building design, changes in requirements, all tend to reduce value and usefulness. The only remedy is to replace and rebuild to such extent as conditions dictate in the specific case.

There can be no valid excuse for failure to maintain factory buildings in good condition and keep them up to date. In the long run it will cost less to do so. Disregard, if you like, such considerations as lower efficiency of production, possible damage to products and equipment, danger to the health of employees, and the psychological effect of poorly maintained, obsolete buildings on all who see them or work in them. There remains the fact that neglect leads rapidly to unnecessary expenditure and destruction of capital assets. These are penalties that industry cannot afford to pay.

MANAGEMENT and maintenance must do something, vigorously and promptly, about protecting industry's buildings. We are in the recovery phase of the business cycle. During the increased production that is ahead, and with so much lost ground to be made up, industry cannot afford the interruptions that would accompany the replacement of roofs, the rehabilitation of floors, the alterations necessary in revising plant layouts and in revamping services such as piping, wiring, and heating.

We are recommending that the work be done now and we accompany this suggestion with an assembly of constructive information on building maintenance. It is contained in a special section in the forepart of this issue.



It's Man to Congressman Now

Flank instead of frontal attack is today's recommended procedure against pending legislation inimical to recovery

L. C. MORROW
Editor

IT IS TIME for individuals to express themselves to their Congressmen about pending legislation. In the early days of the present administration the wishes of the President controlled the actions of Congress; on that account industry and business had to try to make their opinions known at the White House. Today, Congress is again thinking and acting for itself, will listen to the people from back home, is frankly dubious in spots about both recovery and reform legislation.

Perhaps first consideration should be given the NIRA, which the Senate Finance Committee is now trying to revise. The situation is more confused than at any time in recovery's troubled history. Opinion is divided as to scrapping the whole of the NIRA, keeping only the "good parts," making it permanent, retaining only the labor provisions.

Practically all that *Factory* can see as worthy of emerging from the fracas is minimum wages, and we have some lingering doubts about that. We cannot see any justification for price control, limitation of production, inflexible work-hour limitation, except as they may apply in natural resource industries. We cannot condone the much-interpreted 7(a), largely because it can be much interpreted.

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AS THE NIRA becomes a weaker and weaker big stick, organized labor leans more ardently toward the Wagner Labor Disputes Act. This bill would set up the National Labor Relations Board as a control independent of everybody, including the President, and would bypass the Department of Labor. It would make majority rule absolutely binding, outlaw even the mildest "company union." The worst phase is the premise of the class war, which makes adjustment of labor problems on an evolutionary basis difficult, and flaunts industry efforts of the past to reach agreements on a friendly basis.

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ALMOST bedfellow to the Wagner Labor Disputes Act is the 30-Hour Week Bill. If the Wagner bill should get through, and defeat of the 30-hour bill should be conceded in the doing, would not organized labor have gained an effective and undue advance?

May we say again, that we are not constitutionally opposed to organized labor. If this statement appears to be an unqualified tirade against it, that is merely because organized labor happens to be in the position of benefitting by strife-provoking and economically unsound legislation if the Labor Disputes Act and 30-Hour Week Bill are passed.

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THIS IS NO time to write a permanent NIRA. There is no extensive background of experience to justify doing so. The individual units of industry and business can reach no agreement concerning it. Neither can the individual units of the administration itself. The most that should be done is to give it a new lease on life for a year or so, pending certain vital supreme court decisions such as the Weirton case, and pending a settling down of industry and business toward a majority agreement as to its having or lacking requisite permanent value.

This is no time to pass the Labor Disputes Act, because of its strife-provoking proclivities.

This is no time to pass the 30-Hour Week Bill, because it is economically unsound.

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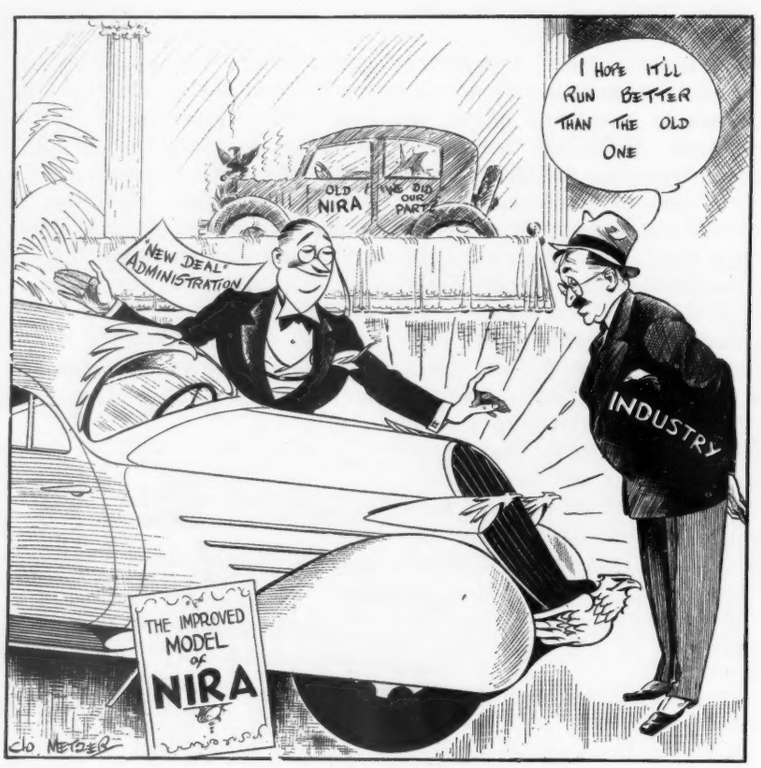
But this *is* the time for industry and business to voice their opinions to their chosen lawmakers, the members of the Congress.



When Industry Decentralizes

Plans that contemplate mere large-scale shifting of industries from one location to another, will be of service neither to business nor to society

DANIEL C. ROPER
Secretary of Commerce

THE PROBLEM of decentralizing industry is one of deep significance. Both the economic and social aspects are of such far-reaching importance that the whole plan, with its many ramifications and implications, must be approached carefully. Recently, a committee of the Business Advisory and Planning Council for the Department of Commerce, headed by William A. Julian, Treasurer of the United States, submitted to me the results of an extensive study of decentralization, and their findings are most pertinent to this discussion.

The report frankly stated that the program recommended by their body was "intended as a remedy for conditions that now exist rather than as a plan to decentralize our industrial activities on a broad national scale."

The committee recommended the establishment by the government of a $2,500,000 revolving fund to be used for loans to small industries in aiding them to relocate their factories in towns that at present are without enough income-paying enterprises to support the needs of the inhabitants even under normal economic conditions.

Stranded Towns

There are many towns throughout the country, the committee reported, that have been built up around a manufacturing or resource industry, such as mining or lumbering, but have become stranded either through failure of the manufacturing project or depletion of the natural resource. This and the general effects of the depression have worked great havoc with the economic and social conditions of the towns affected.

Many of these stranded towns have outlying lands available for farm cultivation, cow herds, chicken farms, or orchards. These towns could be revamped on the self-subsistence basis with the addition of other industries that require only part-time operation. To some extent this has been the underlying thought in developing the government's subsistence homestead projects.

Seasonal Industries

At present, the report continued, we have a large decentralized population without a source of cash income. These families are on relief

Bachrach

and must remain so until industry can be attracted to such isolated areas and supply this income deficiency. With part-time industries these towns can survive and the population remain unmoved because of its agrarian pursuits which absorb leisure time.

Many small industries could give this part-time employment were they located in these stranded towns. These industries are now in cities where, because of their seasonal production, they adversely affect the employment situation during their periods of slow activity. Because of the heavy overhead caused by plant maintenance, the committee pointed out, these industries have made little or no profit during the depression and are in no position to finance a change to rural sections where the decreased cost of operation would benefit them.

In these particular cases, if the loan fund were available, as the Business Advisory and Planning Council recommended, certain companies could be helped to move to suitable locations, thus relieving their financial strain and ameliorating the living conditions of the towns affected.

Money for Moving

The report of the Business Advisory and Planning Council's committee further stated that, although much interest in the decentralization of industry to keep pace with the decentralization of population has been manifested by various government agencies, no department has primary responsibility. It therefore proposes that a department be set up to study the problem and to select and encourage the relocation of such industries as would contribute to the welfare of these communities.

This department would have at its disposal a revolving fund to be used when necessary as loans to industries in defraying the cost of moving and in insuring their success in getting started in their new location. Whereas the fund of $2,500,000 suggested as the amount with which to start the program was not considered adequate to meet all the demands on it, the committee expressed its belief that it would be sufficient to start and maintain the program long enough to substantiate its worth.

Summarizing the report, the committee of the Business Advisory and Planning Council stated:

"We have a great many part-time towns that need part-time industry

to supply the cash income required by the population. We have a great many part-time industries that would have a better chance of success in a rural community, and we have a large city that is now burdened with part-time industries which cause unrest with their intermittent employment. All of these factors will be benefited by this limited program of decentralization:

"1. A selection of the town requiring industrial payroll to reduce unemployment relief;

"2. The proper selection of the industry to fit the town;

"3. A suitable low-cost factory building to rent to the industry;

"4. Provisions for (a) loan to the industry, if necessary, to cover cost of moving; and (b) monthly loan not to exceed the actual payroll to be granted for a limited number of months."

What About the Cities?

There are many factors to be considered in such a program. Decentralization of industry, I feel, should not be carried to the point of shifting industrial plants from metropolitan centers to rural districts at the expense of property owners and general business conditions in the former. Similarly, if city populations were moved with the industries, their arrival in rural towns would do nothing to help the local unemployment situation.

I believe that to a considerable extent rural rehabilitation of industry may best be brought about by the building up of branch establishments and the development of new industries in the isolated communities. This, I believe, is better than a large-scale attempt to move industries bodily from one location to another. The development of branches would make possible the employment of the rural population working seasonally without possible ill effects such as would result from moving an industry overnight and leaving former employees stranded in the city.

Long-Term Planning Needed

It is my feeling that the entire problem of decentralization of industry should be approached only from the standpoint of long-range planning. It is not essentially an emergency problem, although it has emergency aspects and no unnecessary time should be lost in working it out in the best possible way.

Undoubtedly there are segments of business that could in the course of time develop plants in rural regions and thus hasten the day of the rehabilitation of those areas that are now in dire straits. But it would be no service to business or to society to make plans that would amount merely to the shifting of industry from one location to another.

With the development of small industries in rural districts much of the migration from country to metropolitan areas should be eliminated, thus tending to reduce unemployment in cities. Furthermore, as each individual family would be producing food supplies sufficient only for its own needs there should be no cause for alarm that such a decentralization program would affect the general status of the agricultural situation.

Thus it may readily be seen that these problems must be approached with an idea of fairness to the larger centers as well as a desire to ameliorate the living conditions in rural communities and the operating facilities of the industries concerned.

Ford for Farm *and* Factory

HENRY FORD, always one of our greatest "centralizers" — his Rouge assembly lines turned out 160,000 cars and trucks in March— has long been a leading proponent of decentralization.

"Ten years ago"—we quote from a public statement — "we started seven village industries on small water power sites, all within twenty miles of Dearborn, our purpose being to combine the advantages of city wages with country living. The experiment has been a continuous success. Overhead cost has been less than that in the big factory, and the workers would not hear of going back to the city shops. . . . Their security is produced by machine *and* farm, not by one alone."

Village industries are only steps in the right direction, however; do not really bring industry and agriculture together. The missing link is chemistry, and in the chemical laboratory Ford research workers are discovering how industry and agriculture can each supply what the other needs.

Some 20,000 acres are therefore being farmed for everything from sunflowers to soy beans. The crops are passed through the laboratory to learn how they may be used in the manufacture of motor cars and thus provide an industrial market for the farmers' products. Lacquer, for one thing, has already been derived from soy beans.

A few Ford statistics illustrate the possibilities in a closer tie-up between farm and factory. If Ford plants produce the promised 1,000,000 cars this year, they will require the wool of 800,000 sheep, the hides and byproducts of 30,000 cattle, the fleece of 87,500 goats, and the wax of 93,000,000 bees. They will use the products of 433,000 acres of cotton, 20,500 acres of timber, and 12,500 acres of sugar cane. Even 240,000 pounds of castor oil will be needed for some purpose.

Backtracking, Good-By

Last of three articles telling how Murray started right from scratch when 1935 production schedules dictated new layouts

F. E. WIKANDER
Plant Layout Engineer
Murray Corporation of America, Detroit

ANOTHER example of revision of layout to produce a smoother flow of material is found in the new arrangement of the Ford trim lines. Formerly there were six conveyors in the main L of this floor—one was an independent line; the other five were units in a single line that doubled back upon itself twice. In other words, a body in the course of its travels went down the length of the floor and back in two cycles before heading down the last line. Turntables were used at each end of each line to turn the body around and shift it to the next line.

In the new layout, one conveyor has been removed; the remaining five travel in the same direction.

A number of advantages have accrued from this move. Previously, a variety of bodies went down a single line, and an equal variety of materials were carried on the service monorails. Besides, the workers had to be prepared to tackle any job that came along.

In the new setup, like models are on each line, and labor is specialized for each body type. Because the bodies do not have to be turned around, a group of turntables have been removed from the floor at the feeding end and space has been provided for a double bank of bodies on roller stands next to the lowerator that brings the bodies down from the top floor of the plant.

In place of seven turntables there are two transfer trucks mounted on wheels and running on a cross track. Bodies are bolted to steel skids, and a minimum of handling is thus required.

Short and Special

Service monorails, like the one shown carrying dash panels, have been arranged to serve the lines in pairs. Plate glass comes over in a rack-type monorail crossing all lines at right angles. Cloth trim is handled in bucket conveyors parallel to the lines. Backs and seats come down from the floor above on monorails between the lines further down the floor. In other words, shorter sections of specialized carriers have been substituted for the carryalls.

Two transfer trucks mounted on wheels and running on a cross track serve five trim-line conveyors. All five run in the same direction. They didn't use to

Body manufacture requires lots of space, particularly when the requirements of several automobile manufacturers have to be met. Murray Corporation has about 2,000,000 square feet of floor space in fourteen buildings. On this large scale, there is ordinarily a tendency to waste space, but here there has been a studied effort to keep in bounds.

Five years ago, for example, when a new 7-story building was erected, overhead conveyors were installed for the body paint lines in place of the almost universally used floor type. The decision was made on the basis of more efficient use of space.

Floor-type conveyors function best on a long straightway. Otherwise, rehandling on a transfer carriage is required to send the body back on a parallel track in the reverse direction. With a monorail, on the other hand, almost any number of reversals of direction can be accomplished without rehandling or transferring the body. A single conveyor will take a Murray body through the entire system.

Hang the Ovens

In this particular paint layout, even more efficient use of floor space is obtained by hanging the baking ovens from the ceiling, leaving the floor below free for such operations as wet and dry sanding and spraying. Of course, high ceilings are necessary (15 feet, 2 inches in this building).

A plant of this kind demonstrates practically every kind of materials handling equipment, if one includes the power plant with its coal and ash handling conveyors. The tendency is toward more conveyors, rather than fewer, as the object is to keep everything on the move and avoid stationary stock reservoirs wherever it is possible to do so.

Balcony Scene

that adds 3,000 square feet of floor space

SIDNEY HOLLAENDER
President, Ever Ready Label Corporation
New York

WHEN the flood of NRA label orders swamped us in 1934 our production facilities were so strained it was obvious we must have larger quarters. The loft building into which we proposed to go would provide us with 20,000 square feet of floor space, about 11,000 for offices, 9,000 for the pressroom.

As orders continued to pile in, we awoke to the fact that even this floor space would be inadequate. But certain features of the new space—for example, a large elevator for incoming materials at one end of the pressroom and another at the other end for outgoing product, permitting effective straight-line manufacture—were very desirable.

This Way Out

In the ensuing search for a way out (it was not at the time feasible to take more space adjoining what we had) someone observed that the 21-ft. ceiling gave opportunity for the erection of a balcony.

Once suggested, the thing was obvious. We could add 3,000 square feet to the area of our pressroom without its costing us another cent for rent. And the balcony would work well in connection with our layout for straight-line production.

As we finally worked it out, a monorail hoist runs along the balcony so that heavy rolls of paper stock coming in on the receiving elevator can be easily handled into storage on the mezzanine and as readily removed when needed for production. Beneath the balcony are storage space for less bulky stock, lockers and lavatories, and the maintenance department.

Although the illustration does not show it, the balcony also extends across the shipping end of the room, providing space above for stock label storage.

Cost figures? Not considering the savings made by having raw materials and supplies so handy, the cost of erecting the balcony is equivalent to five years' rental for the 3,000 square feet of space it provided. After that we shall be in the happy position of getting 12,000 square feet of space for the cost of 9,000.

Every Worker Has Ideas

Nothing flushes them out of hiding faster than a course in motion study plus a properly organized suggestion system

ALLAN H. MOGENSEN
Consulting Editor

SUGGESTION systems are certainly not new. The first recorded organized suggestion plan in industry was started about 50 years ago. Since that time the idea has increased in popularity until there are at present over 300 large organizations employing more than 1,000,000 workers that are using some form of definite suggestion system.

A recent survey, made by J. W. Walters of Purdue University in collaboration with the National Industrial Conference Board, showed that of 233 companies reporting, 43.8 per cent maintained some sort of suggestion plan. The same report, however, indicates that 21.6 per cent of the total number dropped the plans during the depression.

Lost: Personal Contact

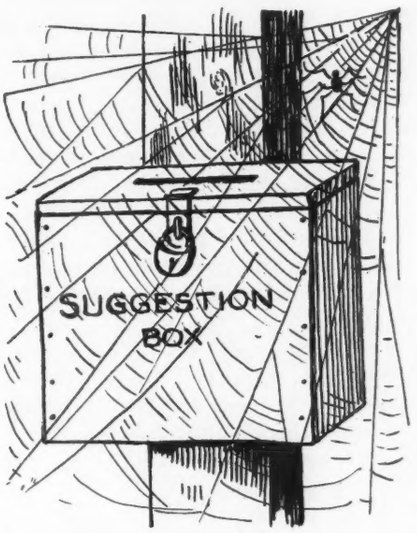
What, then, is wrong with suggestion plans?

In the old days, when most industries were really one-man organizations, employees made their suggestions direct to the owner or manager. Every worker felt a natural interest in the welfare of the business, and close personal contact with the head of the business usually furthered this interest. He felt that his suggestions were welcome, and recognition came in the form of personal thanks.

As industries grew in size, the personal contact between management and worker was gradually lost. This made necessary some form of organization to receive and give careful attention to suggestions.

Usually there is a committee, composed frequently of the chief engineer, production superintendent, representatives of the personnel and cost departments, and a secretary. It is customary to have some sort of receptacle in each department, with blanks easily accessible, on which the suggestion is written by the employee and then dropped into the box.

The suggestion committee receives all suggestions, makes a thorough study of them, and puts into effect those that can be made use of, lists the ones that may apply at a later



If the cobwebs gather on *your* suggestion box, ask yourself these questions:

Am I receptive to ideas?

Do I encourage my men to make suggestions?

Have I a way of giving each suggestion the consideration it deserves?

Have I taught my workers how to analyze problems and present suggestions so that their value is apparent?

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date, and recommends awards. The amount of these awards varies greatly. Some plans have a definite scale of payment based upon savings. Others leave it largely to the judgment of the committee. Some few do not offer a financial award.

Now why is it that suggestions plans are not universally successful?

First of all, let's consider the attitude of the men toward a suggestion system. Most men employed in medium-sized or large companies hesitate to make a suggestion. There are several reasons for this.

Why Workers Resist Change

One reason is well summarized in the report by F. J. Roethlisberger and W. J. Dickson, "Management and the Worker," published by the Harvard Graduate School of Business Administration:

"The success of management depends in large part upon keeping abreast of the times. Management is constantly making mechanical improvements and instituting changes designed to reduce costs or improve the quality of the product. It is constantly seeking new ways and new combinations for increasing efficiency, whether in designing a new machine, instituting a new method of control, or logically organizing itself in a new way.

"It is to be expected that striving for technical improvement would have consequences at the work level. The task of self-improvement is generally delegated to special organizations. Representatives of these organizations are either directly experimenting with the worker (e.g., cost reduction, the setting of price rates, and the technical layout of the job) or indirectly upon him (e.g., redesigning a machine or product).

"Frequently their contacts with the employee are impersonal. They are interested in him only in so far as his actions are related to the problem with which they are concerned. For members of such organizations, research frequently becomes an end in itself. The result of such activity ultimately expresses itself at the work level in the form of incessant change.

"Granted that the technical organization makes for rapid change in the working environment, why are these changes opposed by the workers? There

is no reason to suppose that all of them are detrimental to the worker's interests. In fact, many of them have as their express purpose quite the opposite intention. Many changes are instituted to improve his conditions and make it possible for him to earn more money. Why then, are the workers seemingly organized to resist change? The answer to the question can best be found from an examination of the social significance of these changes to the worker.

"First, it is important to note that the worker occupies a unique position in the social organization. He is at the bottom level of a highly stratified organization. *He is always in the position of having to accommodate himself to changes which he does not initiate.* Although he participates least in the technical organization, he bears the brunt of most of its activities. Because of his position in the social organization, he cannot hold to the same degree the sentiments of those who are instituting the changes.

"Secondly, not only is he asked to accommodate himself to changes which he does not initiate, but also many of the changes deprive him of those very things which give meaning and significance to his work. His established routines of work, his cultural traditions of craftsmanship, his personal interrelations—all these are at the mercy of technical specialists. He is allowed neither to retain his former traditions and codes nor to make new ones of any duration.

"Now these social codes and customs which define his relation to his work and fellow men are not capable of rapid change. They are developed slowly and over long periods of time. They are not the product of logic, but are based on deeply rooted sentiments. Constant interference with such codes is bound to lead to feelings of frustration, to an irrational exasperation with technical change in any form, and ultimately to the formation of a type of employee organization such as we have described—a system of practices and beliefs in opposition to the technical organization."

Sad Experience

Also many workers have a feeling that their foremen will resent their handing in suggestions, and this belief is the outcome of sad experience. Some plans even anticipate this, and offer the suggestor an opportunity to submit a blank bearing a number, to which he retains the stub. Some even announce that the suggestion may be submitted through the regular mail, in case the suggestor does not want to be seen placing his blank in the box.

Also many employees have found that a foreman or someone else has turned down the suggestion only to submit it later as his own idea. This happens much more frequently than is generally realized, and it does not take more than one or two such experiences to sour a man completely on the giving of suggestions.

Some employees doubt the sincerity of the management. Many suggestions are turned down without proper investigation or at least an effort to contact the suggestor and get full details from him. Or if the suggestion is rejected for good cause, he is often not informed concerning the reasons.

"Many employees have found that a foreman has turned down a suggestion only to submit it later as his own idea"

Not long ago, when a program of motion economy was started in a plant and suggestions were asked for, one old employee came up and said he did not believe that the management really wanted suggestions. When pressed for details, he brought out four worn and yellowed blanks, dated around 1907, one of which had been accepted. He insisted that all four ideas were good and should have been accepted. There were no doubt good reasons for rejecting three of them, but failure to explain had closed this man's mind to further suggestions.

Need for Definite Program

The answer to these problems is not as difficult as it may seem. The suggestion plan should be taken out of the class of a temporary set-up to care for the occasional idea that someone in the plant may happen to get. Management must start out with the thought expressed by Darwin when he said, "There are more men with adequate intelligence than we think, but they lack that quality of enthusiasm that is hard to define."

A definite program of training should be set up. This should start with foremen, assistant foremen, group leaders, so that they can pass this enthusiasm along to their workers. A plan of training in commonsense motion economy is perhaps the best possible means of securing worthwhile ideas in making a better product at a lower cost. Operators are taught how to express their ideas. One of the best tools is the process chart. One plant, where such a program has been conducted, insists that all suggestions for improvement in method be accompanied by a process chart showing the advantages immediately to be gained by its adoption.

The handling of the suggestions must be taken away from the committee and delegated to some one individual or to a methods department, depending upon the size of the plant. First of all, the members of a committee all have regular jobs that occupy most of their time. When the committee meets, which is only occasionally, it must go through the suggestions hurriedly.

Few suggestions, unless a motion economy or similar program has been conducted, come in with much of the necessary information. Usually the blank reads, "I think so and so should be changed." This means that someone must go out and make a complete investigation before the suggestion can be given proper consideration. As no one in the committee is definitely interested in seeing that the particular idea be given every consideration, it often is rejected.

It sometimes happens that the suggestion may refer to an improvement in some method or practice set up or at least improvised by a member of the committee, and it is turned down as that member immediately feels it is a reflection upon him.

Credit Where Credit Is Due

With an organization enthusiastically engaged in a program of motion economy, the employee is assured by his foreman that his ideas are wanted and that he will receive credit for making a suggestion that will better methods, cut costs, improve working conditions, or make for safer operation.

The foreman knows he must give his men full credit for those ideas, for if he ever steals one idea from a

(Continued on advertising page 81)

What Goes Up Must Come Down

This concern minimizes handling by unpacking all raw materials close to the receiving point, moving them to the top floors, then letting gravity do the rest

AT THE baking powder plant of the Rumford Chemical Works, East Providence, R. I., particular attention has been given to maintaining a straight-line flow, and eliminating the handling of the raw materials more than once. The latter detail is of special importance because these materials are delivered in heavy, bulky units. For this reason all raw materials are unpacked as near the receiving point as possible and then transferred to the processing departments by mechanical means. The flow is arranged so that the lines never cross.

The ground floor plan on the next page shows the layout at this key point. The cross-sectional elevation of the five-story building is shown in diagrammatic form.

From car to stores, raw materials go on electric lift trucks. Elevators carry them up to the top floors, and gravity does the rest of the handling job. The final slide to finished stores and shipping is made on a spiral chute

Handling Raw Materials

From the floor plan it will be seen that the loading and unloading platforms are located along one end of the building where there is a railroad siding. On the other side there is a motor truck loading and unloading platform.

As the materials are taken out of the freight cars they are placed on skids. These skids are moved by means of electric lift trucks which are capable of raising the loads about 5 feet from the floor. For stacking purposes.

Tin cans for the baking powder are manufactured on this floor, so the bundles of tin plate of which they are made, are stored close to the doorway leading into this department. The proper quantity for each can-making machine is placed on a skid, and a skid load is delivered when needed by electric lift truck.

The powdery materials of which the baking powder is made are received in barrels, bags, and boxes. The surplus is stored in the space marked "storage" and in the space marked "materials," different materials being segregated at different points. These powdery materials are emptied from their containers into the hopper shown at the lower right corner of the figure. These hoppers are practically at the floor level so that it is not necessary to lift the heavy containers of raw materials to discharge their contents.

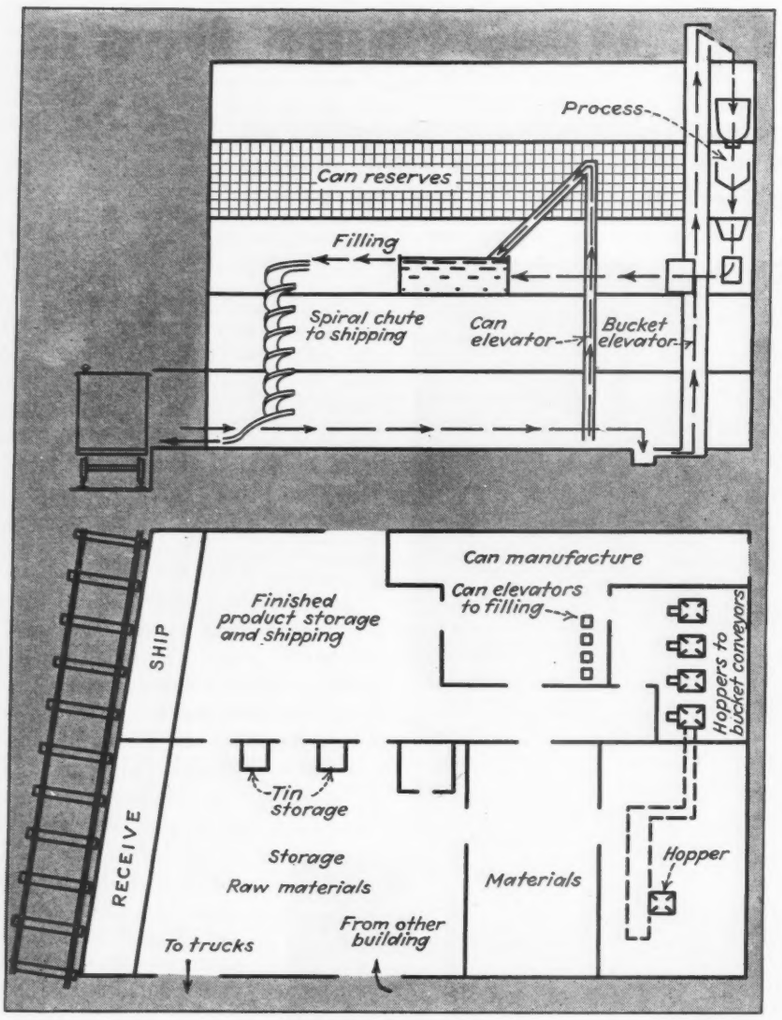
Up to the Top

Materials are then taken by means of underground screw conveyors to hoppers under bucket elevators. Some materials are dumped directly into these hoppers. Thus all the bags, barrels, and boxes in which the raw materials come into the plant do not go beyond the ground floor and do not have to be taken down from upstairs after they are emptied, thus greatly reducing the amount of internal transportation called for and the crossing of lines of traffic.

From the hoppers at the end of the underground screw conveyor system the powdery materials are taken to the top floor by means of bucket elevators and delivered to vibrating screens above another set of hoppers. After once entering these four hoppers the materials are not again exposed to outside contamination before going into the cans as finished goods.

And Down Again

These hoppers on the top floor feed into the mixing machines on the fourth floor through chutes, and from these mixers there are other chutes leading directly to the hoppers above the can-filling machines where the complete process of filling, capping, labeling, packing, and sealing is carried out in a straight line,



actually four parallel lines, by means of packaging machinery and conveyors. Filled shipping containers come out at the end nearest the shipping platform, but on the third floor of the factory.

Four of Everything

Returning to the can manufacturing department, finished cans come out of the machines and roll onto elevators that take them to the fourth floor, above the filling lines. From here they are fed by gravity to the filling machines on the third.

There are four can machines, four elevators, four filling lines. These machines are synchronized by means of variable speed transmissions so that they work together. Also, a system of switches has been provided so that the cans from any can machine may be delivered to any filling machine. However, it is felt to be a necessary precaution to maintain a reserve of a million cans on the fourth floor in case of need, due to failure of the supply of tin sheets or other contingencies. This reservoir of cans is kept in paper boxes brought up from the first floor on skids by the electric trucks, or taken from the elevators on the fourth.

Filled shipping containers at the end of the processing lines are delivered by gravity roller conveyors to spiral chutes and thence to the first floor near the doors opening on the shipping platform.

Right Into Freight Cars

As these chutes pass the second floor the packages may be diverted for storage. They may also be shunted from the chutes between the third and first floors at this point and directed to a chute leading directly to the loading platform. The opening from the latter chute is in the outside wall of the building, and by placing portable gravity roller conveyor sections the packages may be delivered right into the freight cars. This is an especially convenient arrangement when shipping in carload lots.

Packages descending directly to the first floor are placed on skids and moved either into finished goods storage or are taken to the loading platform by electric lift trucks. Thus it will be seen that the raw materials come in at one end of the building, are elevated to the top, then descend and come out as finished products adjacent to the point where they entered without any crossing of lines and without any unnecessary handling of raw material containers.

•

Shared 1934 Profits

PROFIT sharing was very much alive and kicking in 1934. In a survey conducted by the National Industrial Conference Board, information was obtained concerning 134 plans. Of them, 77 were still in active operation, 48 had been suspended temporarily because of lack of profits, 9 permanently discontinued.

Suspension because there are no profits to share is not to be taken as an indication of discontinuance, hence in only 9 of the 134 has the principle of profit sharing been definitely abandoned.

Plans that promote (1) thrift, (2) extra effort, or (3) more equitable bases of compensation show the highest record of success; those that (4) stimulate efficiency or (5) improve morale did not fare so well. The table gives the score for each type of plan.

Profit-sharing plans created to produce extra effort are, in effect, bonus plans. They are most successful, according to the Board's report, when limited to executives and department heads—in other words, to those who understand the possibilities of such plans and are in position to contribute actively to the profit of the enterprise.

PROFIT-SHARING SCOREBOARD

Type	*Total Plants*	*Discontinued*
1	21	2
2	15	8*
3	12	1
4	24	14
5	48	26

*1 limited to executives, 7 extended to all employees.

How I Want My Boss to Be

The "help" talk about you. They say some of the funniest things! Here are a few unimportant tips on bossing — from one who's been bossed

CHARLES S. STEVENSON
General Manager, Hall Brothers, Inc.
Kansas City, Mo.

PAYDAY fell on Labor Day, the preceding Friday night being the last of the semi-monthly payroll period. Closing at noon Saturday would not allow time to prepare the 400 required checks. Consequently the management posted a bulletin, "Payday will be Tuesday. No checks Saturday."

"Boys, I'm going to ask old man Bamford for my check this morning," announced Sam Miller.

"Won't do any good!" spoke up an engraver. "He's turned down one of the stitcher machine girls already this morning. You know him! Once he tells one of us 'No,' that means 'No' for everybody. He's tough, but he doesn't play favorites!"

"The Boss wouldn't be bad-looking if . . ."

As I listened I suddenly realized that here was a virtue in handling employees—Fairness. I realize you bosses meet a lot of people and have to adjust your every word, your every glance, to each employee, but once you start playing favorites your theme song will be "Stormy Weather." All good bosses know this—that's why they're good! I didn't intend to go into the really big qualifications of bossing—you know them anyhow—but here are a few small ones.

"The Boss wouldn't be bad-looking if he'd get his hair cut oftener," remarked a bench girl to her neighbor.

"—and shaved in the mornings, and pressed his pants, and combed his hair, and carried his pencil in his pocket instead of behind his ear, and cut out that galloping he does around here."

"Oh, oh—and what have you been on the carpet for?"

"Was My Face Red?"

"Nothing, but here's the idea. I like my bosses to look the part. Listen. The other night the boy friend and I pass Sexton in front of the show. He tips his hat. I speak. The boy friend says 'Whosat?' I say, 'My Boss.' He says, 'Looked like a stand-in for Moon Mullins,' and was my face red? But that's just about how he looked."

One manager I know reverses the orthodox plan of personal appearance by wearing his "Sunday-go-to-meeting" clothes to work.

"I figure if I wear my clean shirts and best clothes and shave mornings," he claims, "a lot of people will see me—people whose esteem I want. In the evening only my friends and relatives look me over!"

This fellow apparently reasons the same way about his office and desk. The letters and papers there are always in orderly arrangement —no blueprints or samples of work all spread out. There's so little on his desk you can see yourself in the shiny grain, which, incidentally, he keeps well polished. Maybe he does this for effect, but here's a remark I heard him make once:

"An orderly desk or work bench indicates an orderly mind." Not bad, eh? I can almost figure out why he is the boss.

"Well, I see the Big Shot is on the reception committee to receive the President next week," remarked a diemaker.

"Yeah, we noticed that at home last night. The folks saw his name in the list of workers for the Community Fund Drive two weeks ago, too—and in the Scout Campaign."

Outside Standing Helps Inside

The folks under you like to think of you as somebody of importance outside your plant—which might, incidentally, help your standing *inside* your plant. And they like to see your name in the newspaper.

Most successful men look healthy. Are they healthy because they are successful, or is their apparent good health a factor in their success? Somewhat like the "chicken or the egg first" puzzle.

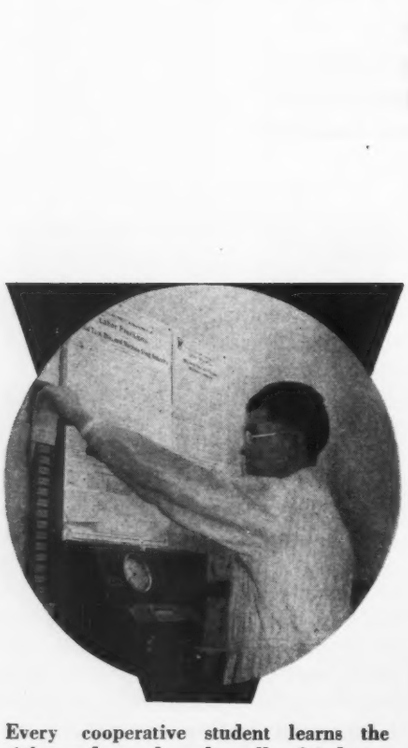
Keeping yourself well dressed, healthy, and civically active won't make a good boss out of you, but it might make some of your help think you are.

Next Month —
Giving the Proverbial Hell

Co-Ops for the Shops

They get horse-sense training for plant-operation jobs—in the classroom, out in the shop

C. J. FREUND
Dean, College of Engineering
University of Detroit



Every cooperative student learns the sights and sounds and smells of industry

IT IS my conviction that more college men will go into the shops from now on. More young men are in college than in former years, in proportion to population as well as in number. This means that more of the shop men will have to come from college ranks because they will not be otherwise available.

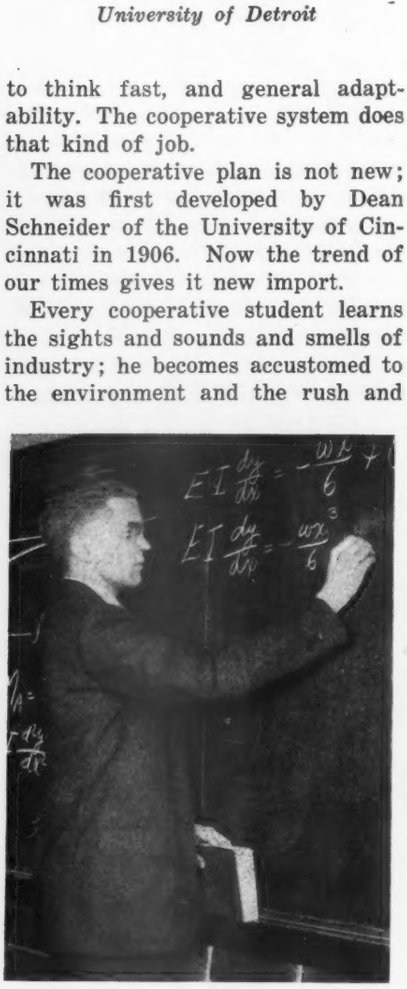
And—more college men will go into shop work because pleasant office jobs are not as plentiful as they used to be.

The Vauclains and Kohlers and Knudsens, whose strength is their experience, have had not a *little* experience but a *lot*. By the time they were twenty-one, many of them had spent nearly a decade in industry; they knew their way about. But you can find the boys of today at home building model airplanes and yachts, fretting about their idleness, in CCC camps. They are not getting industrial experience.

If more college men are going into industry, it is up to the colleges to prepare them better, particularly to give them horse sense, the ability to think fast, and general adaptability. The cooperative system does that kind of job.

The cooperative plan is not new; it was first developed by Dean Schneider of the University of Cincinnati in 1906. Now the trend of our times gives it new import.

Every cooperative student learns the sights and sounds and smells of industry; he becomes accustomed to the environment and the rush and



Half the co-op's time is spent in classroom work closely related to his work in the shop

tumble. He becomes familiar with emergencies.

If the cooperative student is an inspector, he sees what happens to the assembly line when the shop makes scrap out of some part.

They Get the Feel

If he belongs to the maintenance crew, he is certain to find out that under some conditions the quitting whistle doesn't mean a thing.

If he is a superintendent's handyman, he may get assignments to make a drawing, to check the tools on a machine, to calm down an irate foreman, to look up missing parts, to clean out an oil tank. By such assignments he learns to do what he is told and when and how.

Obviously, under this arrangement, the employer becomes an important factor in the educational process and, what is more, he can train his own young men.

For instance, employers of the Detroit metropolitan area are free to select University of Detroit students from a panel of half a dozen boys who seem to be qualified for the job in question. "Final acceptance . . . will be at the discretion of the employing firm." Also, employers may dismiss students as any other employee. "Dismissal from the employ of a cooperating firm will be at the sole discretion of the firm."

Regular Employees

Moreover, "The student, while at work, is in every sense an employee of the cooperating firm, subject to the firm's rules, regulations and hours, and the discipline of its executives."

The cooperative students of the University are employed by many corporations, including the Wolverine Tube Company, Chevrolet Motor Company, Pure Oil Company, Kelvinator Corporation, Great Lakes Steel Company, Ternstedt Manufac-

The cooperative system, for
happen to be unfamiliar
neering education under
vided into equal periods of
students spend these peri-
industry and in attendance

turing Company, Chrysler Corporation, Ethyl Gasoline Corporation, Detroit Edison Company, Fisher Body, and others of consequence.

In a number of plants, officials have worked out comprehensive training programs and schedules similar to the student apprenticeships in the larger corporations; 31 per cent of the students are engaged in typical shopwork such as toolmaking, pattern-making, machine operating, welding, inspecting, and production; 29 per cent are busy with electrical maintenance, testing, installation, service, repairs, and the like; 17 per cent are in metallurgical and mechanical laboratories; only 7 per cent are in the conventional engineering field of design. Miscellaneous employment absorbs the remainder.

How does all this work out? So far, you may tell me, this story is like that of any enthusiastic theorist. Is there any evidence at all that the cooperative system of engineering education prepares for technical shop employments or that graduates tend to go into the shop?

32 Per Cent Go Into the Shops

A committee of the faculty is classifying the graduates of the college, but is not ready to report. However, a quick check, which the report will undoubtedly verify, shows that 32 per cent of the graduates of the University of Detroit are test engineers, tool engineers, layout engineers, timestudy men, plant engineers, reclamation supervisors, service superintendents, production managers, assistant superintendents, metallurgists, foremen, efficiency engineers, construction engineers, chief industrial engineers, heating engineers.

In contrast, the American Society of Mechanical Engineers reported 20 per cent of the mechanical engineers in "technical operation" in 1930; Purdue University reports 5.6 per cent of graduates from 1920 to 1930 engaged in shop employments of various kinds; and in 1926 the Society for the Promotion of Engineering Education reported that 4.3 per cent of older engineers and 29.6 per cent of the younger men are in the shops.

Of course, the cooperative plan is not unique at the University of Detroit. In addition to the University of Cincinnati, where the plan was first tried out, New York University, Massachusetts Institute of Technology, Marquette, Drexel Institute, Georgia Tech, Akron, North Carolina, Pittsburgh, Louisville, Newark, Southern Methodist, and others have offered cooperative courses.

"But what if the boy leaves me after I have trained him carefully for three or four years?"

Manufacturers sometimes ask the question. And here is the answer:

"Sixty per cent of engineering graduates become executives and administrators sooner or later. If you have handled the boy well and taught him to like you and your product and your ways, he will become a nucleus of good will and very likely a good customer."

the benefit of those who with it, is the plan of engi- which the school year is di- weeks or months and the ods alternately at work in upon classes in college

Muscles and Math

D. W. ROBERTS

IT WAS during the close of the '07 panic that our class finished technical school. Jobs seemed to be non-existent, but one man located a miracle, a large steel mill under construction. Soon there were so many of us together there it was like a perpetual class reunion.

Bill and I were electricians' helpers. Bill had not been particularly brilliant in school, but he had exhibited a perseverence in his studies which, with the help of a good tutor, finally won him through even differential equations.

At the time we were members of a gang engaged in stringing bare 350,000-circ. mil. cables through the roof trusses of mill buildings to serve the 6,600-volt meters on main-mill drives. The method was simple. We led a rope through the trusses and snaked in the cable by means of a snatch block and the building crane. Then the hemp pulling line had to be returned through the trusses for pulling another cable.

We made the rope up into coils as heavy as a man could conveniently carry and several of us started back up mill with it, walking on the 3-in. angles of the windbracing connecting the lower chords of the trusses.

Then Bill Laughed

On this particular occasion there were only two coils of rope left to pay out. Bill was ahead with his coil and I was beginning to pay out my rope. Suddenly Bill began to

laugh. He laughed harder and harder until he could scarcely keep his balance on the narrow footing. Realizing he could not long keep upright, he started to strain ahead to the next truss for a hand-hold.

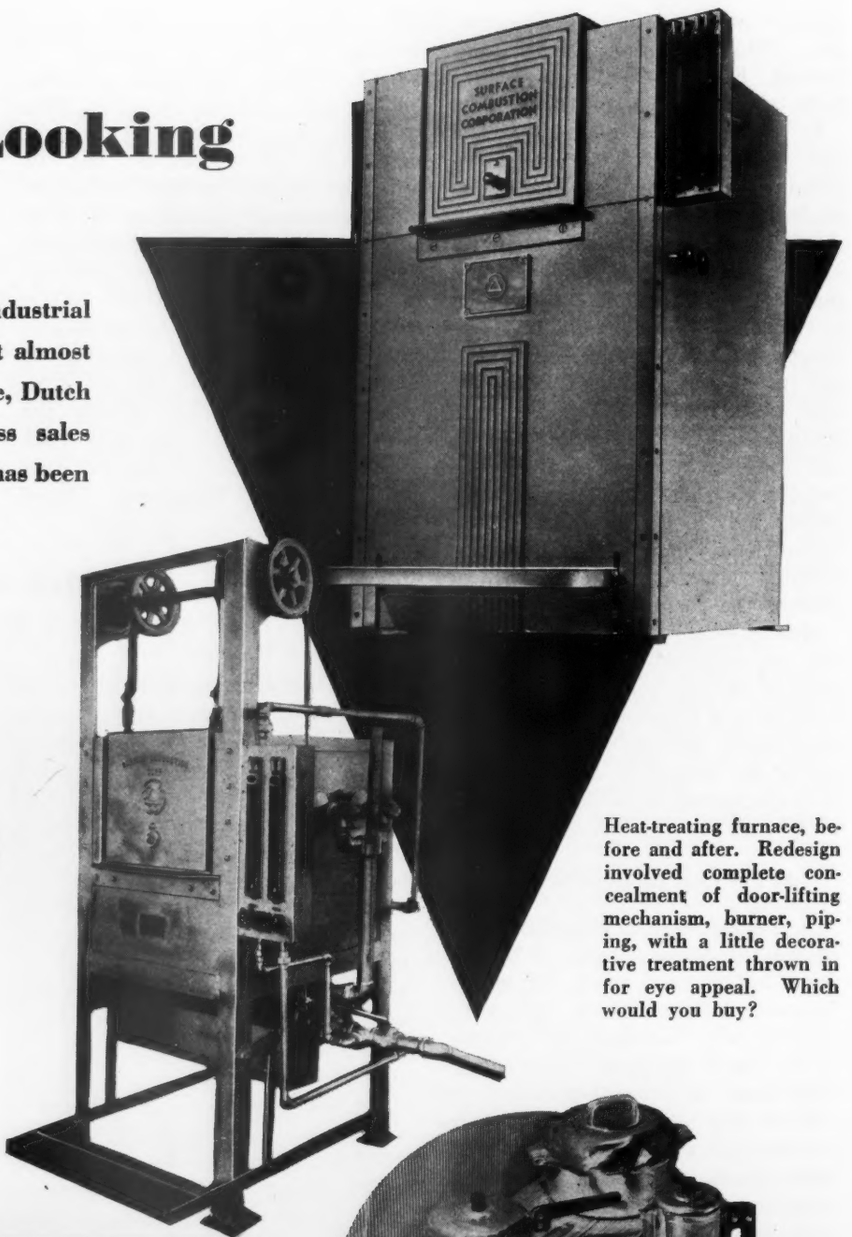
I called out a warning. Bill remembered there was another concerned, gave up the struggle, wrapped arms and legs around the steel work, and had his laugh out.

Somehow I preserved my own balance and reached the haven of the gusset at mid-panel. Naturally I wanted to know what was so funny.

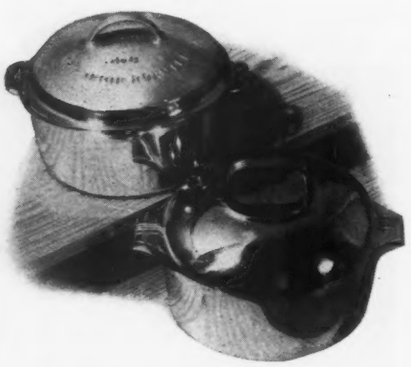
"Oh nothing," replied Bill. "I was just thinking what would we do on this job without our differential equations?"

They're Better Looking

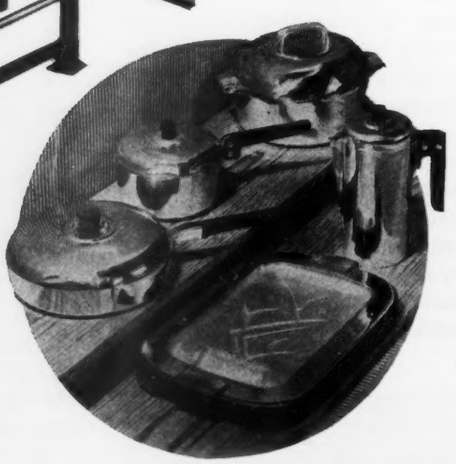
Current successes in the field of industrial design will remind plant men that almost any product—heat-treating furnace, Dutch oven, cosmetic cream—meets less sales resistance when it or its container has been redesigned in the modern manner



Heat-treating furnace, before and after. Redesign involved complete concealment of door-lifting mechanism, burner, piping, with a little decorative treatment thrown in for eye appeal. Which would you buy?



Another "before and after"—cast-aluminum Dutch ovens this time. The "after" has no reading and writing on the cover. Cover is shiny because housewives like shiny covers. Handles are "easier to get a hold of." No bail. A Dutch oven doesn't need a bail



A whole line of kitchen ware has been redesigned. Take the coffee pot. With accessories it makes coffee three ways—boil, drip, percolate. Simple wooden handles make effective contrast with the metal. Tight covers keep flavor in

Looks like a cosmetic landslide to molded plastic jars. Chief advantages are light weight, not-so-slippery surface, adaptability to unusual shapes, ability to stand a fair amount of genteel knocking about

A Home for Research

IBM adds comfort to convenience in its new laboratory, knows it will pay dividends many times over

CORTLAND G. SMITH
Assistant Editor

SINCE that fateful year, 1929, few companies have built themselves new homes. One that has is the International Business Machines Corporation of Endicott, N. Y. This company recently dedicated three new buildings that are models of up-to-the-minute industrial housing. Particularly so is the new engineering laboratory.

Comfort and Convenience

The company is still in the black, despite depression, and the management has shown that 95 per cent of last year's profits came from machines produced by the engineering department during the past twenty years. The engineering staff formerly was scattered, part in Dayton, part in New York, and part in Endicott. One of the three new buildings was designed to house this department, centralized for increased efficiency.

In the new engineering building the management has put into practice its belief that physical comfort, mental well-being, and complete modern facilities and tools have an appreciable effect in raising productivity in research and invention. It learned long since through experience that the extra expenditures for comfort and convenience will invariably be repaid many times by the increased quality and quantity of results.

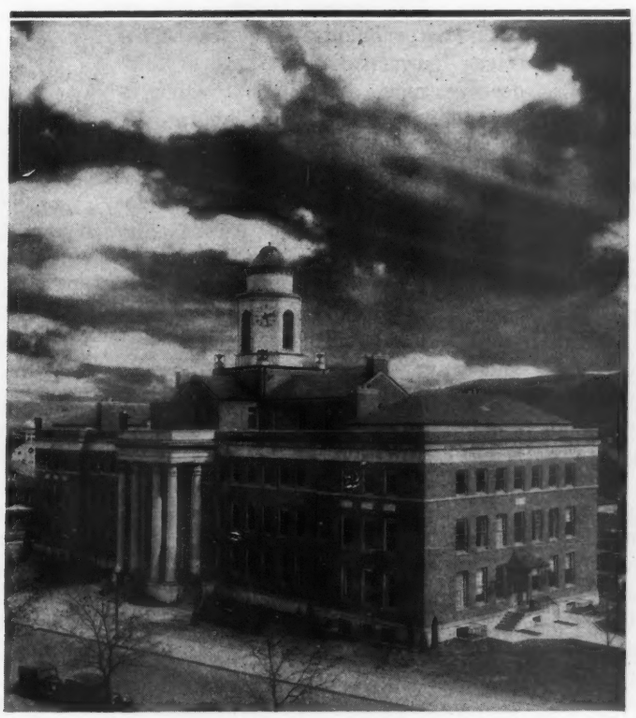
The engineering laboratory itself is three-story Colonial with columned facade, red brick walls, slate roof, and white clock tower. Its air-conditioned interior is decorated throughout in truly authentic Early American fashion.

The seven research and invention departments and the production engineering department are all equipped with similar facilities. The layout of a typical department consists of a drafting room, an assembly and test room, the department head's study, and a cloakroom. Direct fused illumination of high intensity is provided in the drafting rooms from 14-in. lighting globes on swivel-rod hangers. Each assembly and test room is provided with two power distribution receptacles from which can be obtained electric power of any voltage, phase, or frequency, a.c. or d.c., within the working range.

A room is provided for staff meetings, lectures, and motion picture displays. The library contains more than 2,000 textbooks, references, papers, abstracts, theses, and institute proceedings. It has beamed ceilings, paneled walls, and high intensity, semi-indirect illumination.

Even the clock tower reflects the combination of beauty and utility, for it makes an ideal housing for the control station of the elevator. The clock is controlled from the central line station in the basement, which provides centralized time control for the entire plant with automatic hourly correction of all clocks, time stamps, and recorders.

In its engineering laboratory IBM has put into practice the belief that physical well-being and complete modern facilities increase productivity in research and invention



Exacting Experiments

The experimental machine shop is equipped for the exacting work of making precision parts. Light machines and toolroom are located on the first floor; heavy machine room, grinding department, and stockroom in the basement. Circular revolving shelves are used for tool storage. Exhaust air from grinder hoods is filtered and re-introduced to aid in the efficiency of the air-conditioning equipment.

Because the type and condition of the paper used in this company's business machines has an effect on machine operation, a paper-testing laboratory is maintained. The hair line accuracy in weather control is accomplished by a specially designed air-conditioning system and by insulating all sides of the room with 8 inches of cork. Wood blocks cover the cork on the floor.

Unlike the main air-conditioning system, all air in this unit is first brought down to dew point to condense the moisture. Then heat

A view of the model-making room. Every department of the laboratory is air conditioned

and water spray are added. Automatic temperature control at any point between 0 and 130 degrees Fahrenheit, and automatic relative humidity control at any point between 10 per cent and dew point, are obtained by thermostat and hygrostat. Readings of both instruments against time are automatically recorded.

The room thermostat controls the amount of steam going into the heating coils; the hygrostat controls the amount and temperature of the water spray. Relative humidity is held within a maximum variation of 4 per cent, temperature within 2 degrees.

As in the main conditioning unit, all metal parts on ducts, coils, fans, and water sprays coming into contact with the air are constructed of aluminum.

Time Is of the Essence

Time is of first importance in the design of many of the company's products. The time center, erected in the building basement, rivals the accuracy of college observatories with errors of no more than 1.05 seconds per month. Such accuracy is obtained by mounting a totally enclosed pendulum swinging in a vacuum and magnetically impulsed on a pier sunk 40 feet in the ground. The pier is divorced from the building's foundation so that vibration and disturbances in the building will not be transmitted to the pendulum, detracting from its accuracy. This time center controls the hourly self-corrective system of clocks in the entire plant, rings all bells, controls the clock tower floodlights.

There are, in addition, the blueprinting department (provided with apparatus for reproducing worn tracings at a fraction of the cost of retracing them) and the Hall of Products, in which are displayed representative models of the company's complete line of business machines, and which is furnished as a reception room for visitors.

Distribution System

The experimental and test electrical power distribution system deserves note. A main control board is located in the electrical laboratory, to which is delegated responsibility for its proper function. Direct current power at 2 to 48 volts, 110 to 220 volts, is available. Alternating current power is provided at 110 to 220 volts, 60 cycles single-phase, 220 volts, three-phase and at any desired frequency between 20 and 60 cycles, and any voltage from 220 to 6, single- or three-phase.

Plant layout—a plating department this time—is again featured in a leading May article

Standard 110-220 volt, 60-cycle, three-phase a.c. and 110-220 volt d.c. power are available by plugging in at either of the two power receptacles in each assembly and test room. When special combinations of voltage, frequency, and phase, a.c. or d.c., are desired, the assembly and test room telephones its needs to the electrical laboratory where the power is made available at the desired receptacle within a short period.

Sanitary features of the building include a toilet in each private office and a general toilet on each floor and in the basement, twelve drinking fountains, two of which have individual refrigerating systems, and a shower and locker room in the machine shop.

Lighting Not Overlooked

Semi-indirect illumination is provided in all offices, and direct lighting in all laboratories, drafting rooms, stairs, halls, assembly rooms, and machine shops. Illumination of the time center is totally indirect.

The basement houses, besides the time center, a complete stockroom in which are stored all necessary materials, four model storage rooms, a physical testing laboratory, a heat-treatment room, a main switchboard room containing the necessary electrical equipment for the main power distribution system, and a communicating tunnel connecting the building with the factory buildings across the street.

If You'd Pay Less for Power

Start in by taking stock of the equipment you already own. You may not be putting it to the best possible use

WILLIAM W. GAYLORD
Consulting Engineer, New Haven, Conn.

CAN OUR power and heating costs be reduced? Industrial executives are asking this question more and more frequently, and the answer is usually YES. However, it requires a careful study of the actual plant requirements and the most economical ways of meeting them. It is not enough to buy coal or power at best possible prices. They must also be utilized to best advantage.

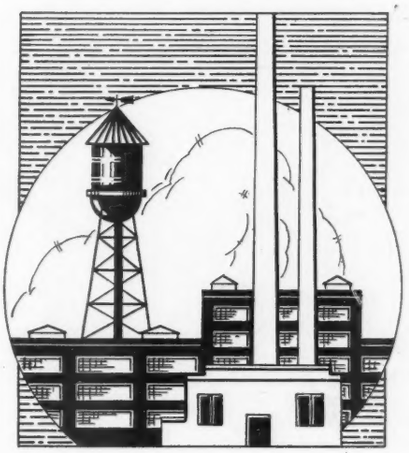
Power and heating costs can seldom be considered separately because in New England and other northern states building heating is a very considerable item for at least six months in the year and many industries require more or less process steam throughout the year. These conditions usually have a marked effect on the method of securing power and heat at lowest cost, and often require an entirely different set-up than for power alone.

In Plants That Have Their Own

Many plants already have equipment installed which, when intelligently operated, will produce power at a lower cost than it can be purchased. In many others the replacing of one or two inefficient units with modern equipment designed to suit the particular conditions, which can often be done at a relatively small investment, will show surprising returns even where the installation of a new generating plant would not be justified.

A careful check of the methods of operating the power and heating equipment may reveal unsuspected possibilities of savings that can be obtained with no additional investment. Selection of a fuel that is particularly adapted to the existing boiler furnaces and that will give satisfactory operating results at the lowest over-all fuel cost will often make a handsome saving.

For example, in one plant purchased power had been substituted for generated power because the power company promised a saving of from $500 to $1,000 per year. The management thought it was saving about $500 a year but had no proof.



Investigation showed that the generating plant was about 15 years old, of fair design, and in good operating condition. Steam was required for process work the year round, and there was a large winter heating load. The present equipment consists of two hand-fired, sectional-header, water-tube boilers, each rated at about 160 horse power, designed for 200 pounds working pressure with no superheat and two non-condensing turbo-generators of 100-kva. capacity.

The Operator Thought

The average electric load is about 50 kilowatts with a demand of about 70. Before power was purchased, the boilers and turbines had been operated at between 90 and 100 pounds because the operator thought he was saving money by carrying a lower pressure in spite of the fact that considerable exhaust steam was wasted in all but the most extreme weather, and that in summer fully 80 per cent of the steam was wasted.

The following approximate annual operating costs for power, heat, and process steam under various methods of operation were calculated from the coal and load records available:

1. Power generated with present plant, boiler operated at 100 pounds $8,100
2. Power purchased, boilers operated for heating and process steam only 7,800
3. Power generated with present plant, boiler operated at 200 pounds 6,800
4. Power generated, one new turbine installed on present generator and operated at 200 pounds 6,300
5. Power generated, one turbo-generator replaced by uniflow engine generator unit 6,000

The investment required to install a new turbine on one of the present generators is about $1,750 (other generator unit to be kept as spare); for the uniflow engine unit, about $6,000.

The Figures Show

These figures show that, while there was a saving by the use of purchased power, it was small compared with the saving that could have been made by proper operation of the existing plant. The figures further show another worthwhile saving can be made by installing a new turbine on one of the present generators, but that the investment for a uniflow engine driven unit will not be justified.

At present there is a great deal of talk about reductions in the rates of purchased power, and some reductions have already been proposed. While these will of course make some reduction in the cost of purchased power, in many cases they complicate rather than simplify the situation and make a careful study of the whole power problem even more necessary if the lowest over-all costs are to be obtained.

Skid loads of shingles won't pile. Too heavy. Hence this double-decked system. The I-beams are removable, allow access to every last corner of the warehousing area

Twice the Storage

At half the cost. Credit it all to lift trucks, skids, and a smart double-decked warehousing system

GEORGE E. SMITH
Assistant Superintendent, Bird & Son
Norwood, Mass.

SINCE roofing, as we make it, consists in the main of felt saturated with asphalt and surfaced with crushed slate, the movement of materials presents a fairly difficult handling job. To complicate matters still more, increased demand for this product has necessitated frequent additions to process and storage space.

Tried the Truck-and-Skid Cure

Some years ago the company decided to try electric trucks in connection with a skid system for internal transportation. This method of handling has worked out so well that more trucks have been added from time to time, and at present there is a fleet of eleven in operation.

During the expansion period, the company was confronted with a difficult storage problem. Roofing materials are made in a variety of colors, and it was necessary to devise some manner of storage whereby the more popular colors would be readily accessible and still not block access to the slow-moving stock.

Unlike many other products, skid loads of asphalt shingles could not be tiered as the edges of the upper metal skid would cut into the shingles on the lower load; since each skid with its load weighs in the neighborhood of 2½ tons, a great many of the shingles in the lower load would be ruined. This problem was met by double-decking skids on removable I-beams. (See photograph.)

In 1920 an additional building was erected, and it had to be built on a higher level than the main storage and shipping floors. A ramp was installed between the old and new buildings with a grade of 6 per cent. The negotiation of this ramp with any sort of load would be an impossibility for a hand trucker, but the electric truck carries a 3-ton load up it with ease.

Cost of Operation

The cost of operation for this fleet of eleven trucks proves interesting when reduced to an average cost per day per truck. Truck age varies from 3½ to more than 14 years; average length of service is 9.67 years. For the past two years trucks have averaged 12 hours per day, 26 days per month. Repair costs have been only $6.30 per truck-month, with the exception of tire replacement which runs about one complete set every two years.

In order to arrive at some basis upon which to compare motorized hauling costs with costs under a hand-trucking system, here is a tabulation of all costs of labor and maintenance:

	Per Day
Parts	$0.25
Labor—cleaning and greasing	.20
—maintenance and repairs	.25
Depreciation, based on duplication of fleet at present prices — 10-year basis	.64
Battery cost, including labor for charging, charging current, and depreciation, and including 5 spare batteries	.86
Total truck expense	$2.20
Operator's time	7.20
Total cost of operation per truck per day	$9.40

At the present time, there are three men and the truck driver in a loading gang. This gang of four men with the electric truck will load cars of roofing at a cost of 24c. per ton. In the hand-truck days, a gang consisted of six men and three hand trucks, and cars at that time were loaded at a cost of 49c. per ton.

They All Go to School

Goodrich doesn't stop at training supervisors. It goes the whole distance and offers every worker an opportunity to get more education

PAUL L. DILDINE
Manager, Factory Standards Department
The B. F. Goodrich Company, Akron

THE MANAGEMENT of our company believes in training its employees. For several years past, training classes have been conducted during the winter months for supervisors and other key personnel in the organization.

Events of the past two years have placed additional emphasis upon these training programs. The shorter working week brought about by the codes has given employees much more leisure than previously. Many are utilizing this additional leisure time to improve their mental capacities.

Industrial adult education has acquired a far greater significance, however, than merely as a means for filling in one's leisure time. It has been, is, and will continue to be necessary for the young, the middle-aged, and those beyond middle age to adapt themselves to new situations. The industrial changes of the past few years have made necessary the constant study of the new industrial trends by those who "would stay in the running."

Helps Keep Them Posted

In an organization as large as ours, it is difficult for employees to keep informed on developments within the establishment except through an educational medium expressly organized for that purpose. The management also believes that developments in the industrial world outside the company can best be surveyed, analyzed, and interpreted through the medium of well-organized and well-planned conference discussions. This is particularly true of those outside developments that bear a distinct relationship to our own industrial endeavors, and whose significance can be profitably analyzed and interpreted in the light of that relationship.

Experience in adult educational work indicates that the work consists of two important phases. One phase deals with the subject matter to be presented to employees; the other deals with the technique of presentation.

The volume of subject matter is almost limitless. The entire range of industrial activities and the relations thereof with the economic and social world comprise pertinent topics for industrial educational discussions. Typical topics in past years have been quality of manufactured products, wastes every foreman can prevent, principles of motion study, equipment maintenance, methods of reducing costs, safety, and losses through spoiled work.

This Year's Program

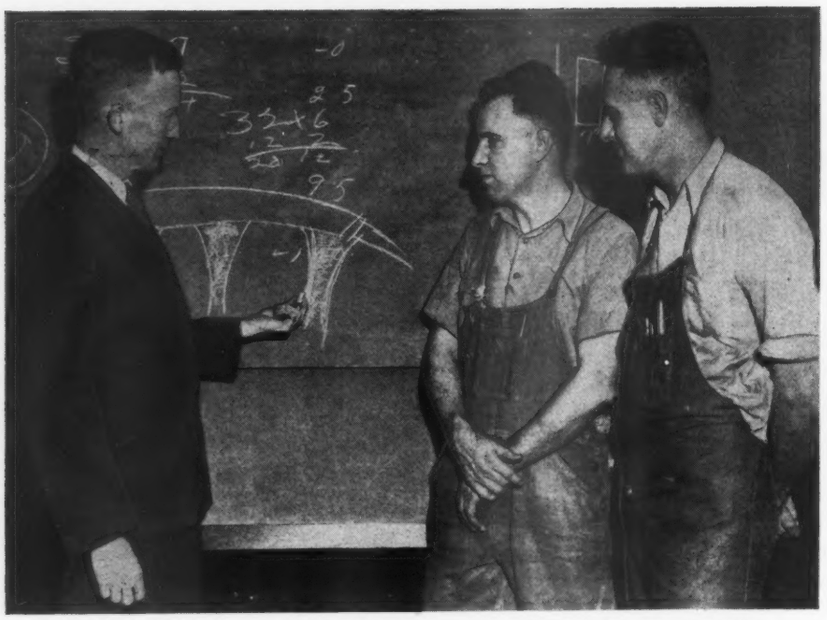
The national emphasis now being placed upon the human factors in industry has rendered topics on the order of personnel relationships very pertinent this year. Our present program includes such subjects as factory organization, methods of wage payment, employee activities, annuities and insurance, and stabilization of employment.

Pooled Experience

Effective technique in the presentation of these subjects is important in that it differs greatly from the ordinary scholastic techniques employed in secondary schools and universities. The students are adults who have had some first-hand practical experience in the subjects under discussion. In many cases, they have preconceived ideas born of their experiences. The presentation of the subject matter must be adapted to matured minds.

We feel that the conference method, as developed by the Federal

They'll all be orators by and by. A typical Goodrich class in public speaking



William Zitzeberger and P. J. Dulude came to school right from the shop

Board of Vocational Education, is particularly well adapted to industrial training groups. By use of the skilled technique of trained conference leaders, each attendant of the conference is encouraged to contribute his practical knowledge of the conference subject for the benefit of all enrolled. Individual contributions of knowledge are thus pooled for the benefit of each member of the group.

This pooling of group experiences represents the major distinction between ordinary educational methods and methods adapted especially for adults actively engaged in industry.

Training Conference Leaders

Our company has therefore employed the conference method very extensively in its supervisory training programs. The first step in such a program is to recruit and train conference leaders. Twenty-five outstanding members of the regular supervisory and staff personnel were selected for this purpose, and assigned part-time to this work.

The intensive training of this group in conference leadership was supervised by Prof. Russell J. Greenly of the University of Akron, in cooperation with the Ohio State Board for Vocational Education. The training extended over a period of three months.

Instruction and practice work were afforded in the technique of conducting conferences. The art of stimulating constructive thinking and coordinating the ideas of individuals in the conference group was taught and practiced. Leaders were instructed in the handling of difficult situations which frequently arise in the course of discussions. Certificates were awarded to those who satisfactorily completed the conference leadership course.

Conference Groups

Next we organized the 700 supervisors throughout the plant into conference groups of 30 to 40 each. A trained conference leader was assigned a given subject and led the conferences on that subject for several groups. This assignment of subjects was economical in that it cut down the amount of time required for preparation and was more satisfactory than the assignment of a leader to a given group would have been.

The early series of conferences dealt with topics that were everyday problems for all supervisors. Aside from an introductory statement and a definition of the topic by the conference leader, the content material consisted almost entirely of the responses of each group to the subtopical outline used by the leader.

Result: A Supervisors' Textbook

Responses of the group were compiled by the conference leader in outline form, mimeographed, and distributed for future reference to all supervisors enrolled. The result at the conclusion of the conferences was a supervisors' textbook, which was compiled by the group and represented group thinking on each topic discussed.

Topics concerning which the members of the group do not possess first-hand knowledge were presented, and stillare, through the medium of a monograph prepared for the purpose and distributed to the group in advance of the conference. Conference discussion centers around the subject matter of the monograph, and is otherwise conducted as described above.

Bringing School to the Plant

We have also embarked on another educational program which has proved of vital interest to a large group of employees. Members of the faculty of the University of Akron are conducting afternoon and evening courses in industrial electricity, business mathematics, business English, metallurgy, psychology, public speaking, salesmanship, sewing, shorthand, and typing.

Classes are conducted in company conference rooms. Courses are particularly adapted to the practical needs of those enrolled. The principles evolved in these courses may frequently be put to immediate practical use. No college credit is given, and the tuition fee paid by those enrolled is usually low.

It is company policy to utilize local educational facilities whenever available and not to embark upon educational efforts that are competitive with publicly supported institutions already established. It is believed that the final outcome will result in a personnel better equipped to cope with daily problems as they may arrive within and without the company organization.

●

FACTORY'S
Plant Operation Library

March—*Foreman Training*
April—*Building Maintenance*
May—*Standard Costs*

●

You Want to Know

. . . and the editors will gladly tell you . . . more about the things mentioned on this page

• SCREWDRIVER, electric, has an adjustable clutch arrangement that automatically releases at the same torsion point for each screw, insures uniform driving.

• PAPER does such funny things that when British surveyors have plans they want to keep permanently accurate, they engrave them on aluminum plates.

• THERMOPLASTIC synthetic resin, colorless and highly transparent, is derived from coal, transmits ultra-violet rays of sunlight, will dye any color, may be cast into sheets, rods, blocks that machine with ease.

• WHAT lock nuts and washers to use with bearing cones? A manufacturer offers charts that tell all.

• PETROL — gasoline to you — is being extracted from coal by a British concern that will by June be producing 2,250 gallons a day plus 120 tons of smokeless fuel.

• LATEST pre-fabricated house employs light-gage structural steel shapes in combination with plywood (phenolic resin glue) panels. Glue is moisture-proof, won't support combustion.

• SOCIAL SECURITY is the great delusion, according to a new booklet that "not only describes harmful results from this further attempt to interfere with economic law, but also offers a sound program."

• INDUSTRIAL ANALYZER is what they're calling a new instrument that is volt, watt, ampere, and power factor meter all in one.

• CLIPS, pins, thumbtacks, etc., went so big in a handy "bookshelf" dime edition that the manufacturer is now placing a bigger edition on the market for office use.

• METALLIZED PAPER has a high-lustre finish resembling foil. Won't peel. Resists oils, greases, water, humidity, tarnish, corrosion.

• PURIFIER filters water vapor, oil fumes, and dust out of compressed air, thereby increasing safety of workmen and life of equipment.

• FIRST AID to worn gear and pinion teeth may be rendered by a new hard-surfacing electrode designed to build up straight carbon steel, low alloy or high manganese steel surfaces.

• CHROME NICKEL (18-8) alloy fittings are designed to eliminate "pockets," thus meet the demands of food and other manufacturers for completely sanitary piping.

• BOOTLEGGERS can't do anything about a "locked bottle" just introduced. Insert a key, twist the wrist, and off comes the neck—for keeps.

Snow lights but never sticks, ice cannot form, on this experimental stretch of sidewalk. Reason: asbestos-insulated lead-sheathed industrial heating cable laid one inch below the surface causes temperature rise of 20 degrees

• GAS-OPERATED unit for homes, commercial buildings, and industrial plants is the big news in the air conditioning industry.

• ALL-STEEL platform truck is all-welded. Built closer to the ground, it's easier to load.

• PLUG for large or small holes in liquid, air, or vacuum containers is made of strong, ductile metal which expands and forms a three-way seal.

• CARBON MONOXIDE is the cause of the fourth largest group of occupational diseases, accidents, and deaths. Want a new booklet that tells all about it?

• COPPER in a new liquid form may be applied to any surface by spraying, dipping, or brushing. Crystalline structure of mineral has been broken down, yielding shapeless particles that go through a 350-mesh screen.

• PAINT CLEANER mixes in cold water, can be used on any surface, "dissolves" dirt, no rubbing or scrubbing.

• ALL-RUBBER lamp cord will never fray, comes in colors, has a series of ridges molded into its outer surface to make it look nice.

• WRAPPING material, new, is made of two sheets, the inner a light, flexible, corrugated paper, the outer a heavy Kraft paper.

• GOOD for factory aisles, runways, stair treads—a new steel floor plate designed to assure highest degree of skid resistance from every angle.

• STAIR TREADS made from steel grating never rattle because forged into one piece. Twisted cross-bar feature makes slipping hard to do.

• FLASHLIGHT 3 inches long, ½ inch in diameter, uses a special new bulb no bigger than a kernel of corn, retails for 20 cents.

• IF YOU WANT large (10x4x2) plastic boxes in quantities too small to justify your own molds, you can get them.

• LIGHT SOURCES for new photo-electric burglar alarms are equipped with infra-red color caps to make the beam invisible.

OPERATING SHORTS

Cable Banks Lowered to Run Conduit

J. W. WRIGHT, *Montreal, Canada*

A 75-ft. run of fiber conduit incased in concrete had to be installed for the cables leading from a turbo unit to its disconnecting switch in the bus compartment. Part of the distance was clear of obstruction, but in a space of about 20 ft. were two 8-inch water mains, two tiers of 750,000 cm. lead-covered cables carried on hangers made from channel iron, and a row of iron conduits, all suspended from the beams of the floor above.

To carry the ducts under the 8-in. mains would leave them too low, but if they were passed above the mains where there was ample room, the two tiers of cables were directly in the way. A suggestion was made that the cables and hangers be lowered a distance of about 12 in., to leave a clear path for the fiber conduits.

The engineer in charge accepted the proposed plan and this method was employed to bring the conduits into place.

A staging was built to within 12 in. of the lower tier of cables, and twelve 1-in. boards were smeared with soft soap and laid one on top of the other on the staging in three places. The soap was used to facilitate the removal of one or two boards at a time while they were carrying the weight of the cables. Next, a few lengths of 2x2-in. scantling were inserted between the two tiers of cables, to prevent the edges of the channel irons carrying the upper tier damaging the lower cables, as the hanger bolts were removed to lower the cable banks.

After the staging and stack of boards had been placed, the bolts were removed from three of the hangers, allowing the weight of the cables to rest on the stack of 1-in. boards for some distance to either end of the staging. The hangers were lowered by backing off the nuts, the bolts being sufficiently long to permit this. Then in succession, one after another of the 1-in. boards was removed from each of the stacks by driving it out, the soapy surface making it quite easy. By following this method, the two tiers of cables were gradually lowered until sufficient clearance was obtained to allow the fiber ducts to be passed above the cables.

A form was made of metallic lathing and secured to the hangers supporting the ducts. Then a coating of cement was applied to the outside, making a good form to hold the concrete used in covering the ducts, and leaving a finished outside appearance as well.

Longer hanger bolts were now used to suspend the cable hangers, and after adjusting the remaining hangers for some distance to give a gradual slope to the cables, the temporary spacers and staging were removed. During the entire operation the cables had continued to supply power.

Mr. Wright's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.

•

To protect workers along the east and west sides of its plant from the glare of the morning and evening sun, American Chicle Company, Long Island City, N. Y., uses light diffusers of white muslin mounted upon wooden frames. Hung about two feet from the window, they effectively prevent glare yet do not shut off the light.

A Platform for Getting at High Windows

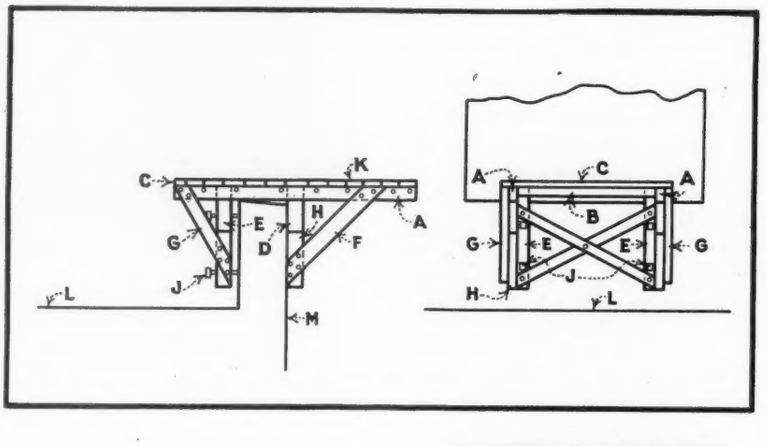
JOHN E. HYLER, *Peoria, Ill.*

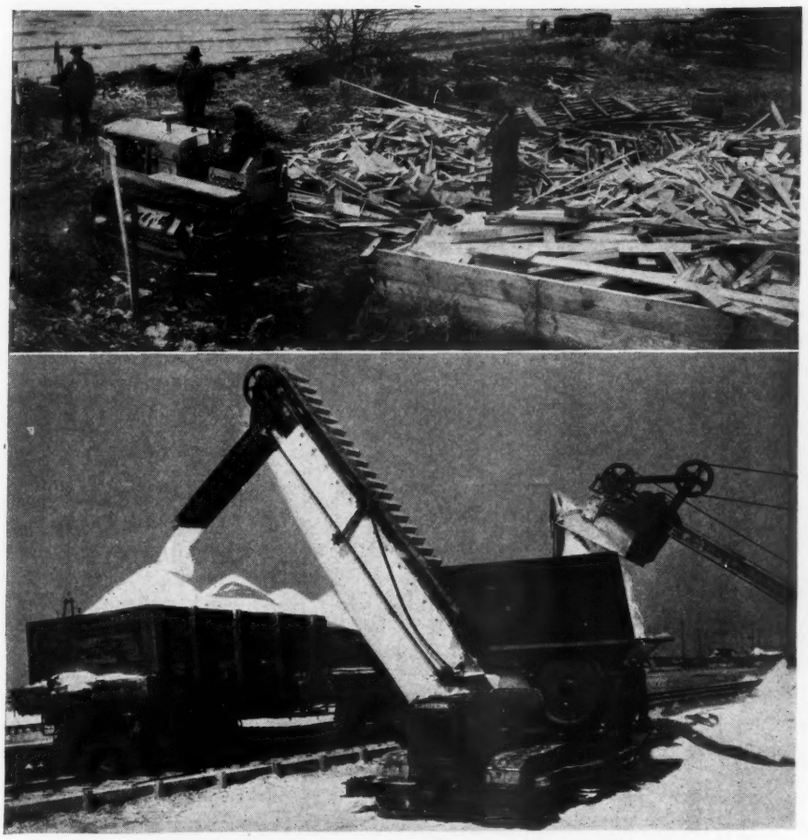
The platform shown here is of particular value for use on the upper stories of plants where getting at the outside of windows for washing, re-placing broken glass, etc., is ordinarily very difficult. Only the man who has done it fully realizes the inconvenience of standing on a high ladder or working from a sling.

The principle used in building the device is that of mounting a platform on four legs, so that the legs will straddle the window sill and the masonry. The legs must be set a little farther apart, in most instances, than the thickness of the wall, to get the device into place readily. After it is in place, it is made rigid by driving four lagscrews through two of the legs (the ones inside the building) so that their points drive against the masonry to make the platform tight and secure.

Two runners *A* are combined by nailing with cross-pieces *B* to form a frame upon which is nailed the flooring of the platform *C*. The two legs *D* and the two legs *E* are rigidly held in relation to the platform by nailing to the runners *A* at the top and by triangular braces *G* and *F*. Blocks *H* are interposed to bring the triangular assembly into better nailing alignment. After the lagscrews *J* have been put into place, an X-brace of light material is applied across the two legs *E*. A similar brace is applied across the two outside legs *D*, making the whole structure absolutely rigid.

When this device is in use in the winter, the lower window sash can be let down into contact with flooring *C* while the worker is outside upon the platform, so that very little cold air is admitted to the plant.





Hauling scrap lumber to the waste heap is but one of the many ways a tractor serves E. I. duPont de Nemours & Co. at its Edgemoor, Del., plant. At the Royal Crystal Salt Co., Saltair, Utah, a tractor placed inside the frame of a salt crusher and elevator supplies the power for the operation of crusher, elevator, and itself

Castor Oil Solves Belt Tension Problem

M. E. WHITE, *Chattanooga, Tenn.*

The search for a theoretical formula for the tightness of belts, was for years the plague of my life. I didn't find it—but I found something else.

While visiting another plant one day, the extremely loose belts attracted my notice. One, in particular, was striking. A belt driving a dynamo was so loose that the upper, or slack side, was actually in contact with the lower, or pulling side, for at least three feet.

When I inquired how they treated their belts to make them work in such a loose condition, I was told, "We keep our belts clean and thoroughly lubricated with pure vegetable castor oil."

Since then I have forgotten there is such a thing as a theoretical formula for the tightness of belts and have relied on good old castor oil to stop slipping, straining, and other belt troubles.

New belts are usually stretched out on the floor while a liberal coating is applied and allowed to soak in. Any excess is wiped off, and the belt is cut to a loose tape-line measurement and put in place.

On old belts we usually apply the oil lightly but frequently with a brush, until it has worked out all old dressing, oil, and dirt.

A light application every two to four weeks has kept our belts in excellent condition under the most adverse conditions.

•

Changed to Oil, Saved $93 a Month

SOURCE, *Vogt's Ice Cream, Inc. New York*

An oil-fired boiler installation that cost $1,400 has cut the monthly operating cost in this plant to $32 a month as against $125 monthly with the original gas-fired boiler.

The original installation was a 10-hp. unit costing $800, and was designed to furnish steam for pasteurizing and sterilizing. After 3 years of operation the change to oil firing was made.

Since more capacity was needed, together with higher pressures, an entire new installation was made rather than adapting the old boiler to oil firing. The new unit, which has a capacity of 15 hp., gives pressures between 70 and 80 lb. and in two years of operation has averaged $32 a month for fuel at 6c. a gallon.

The gas-fired boiler was retained and is used occasionally as a relief unit, but never enough to exceed the minimum service charge.

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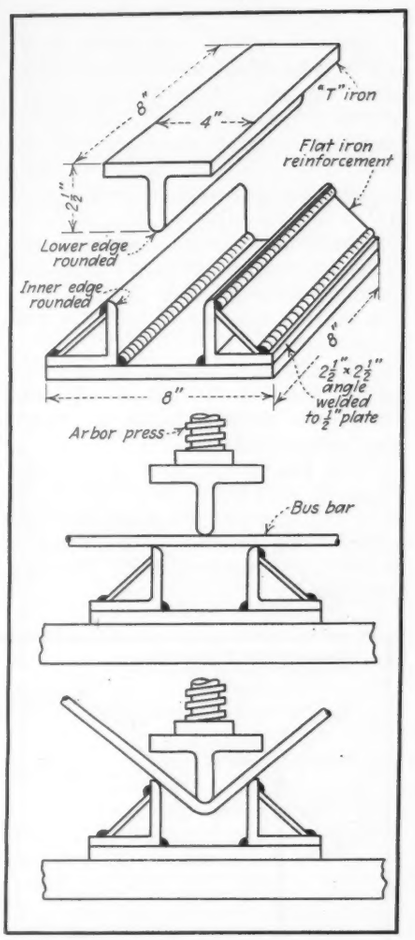
Inexpensive Busbar Bender

CHAS. A. PETERSON
Electrical Department
Bendix Products Corporation
South Bend, Ind.



Most industrial plants use busbars behind the main switchboards and distributing panels. When making changes in the busbar structure it is almost impossible to make neat bends in the heavy copper bars without some kind of bender. However, com-

paratively few plants possess such a device, since need for it arises only at long intervals.

The illustration shows a practical tool that can be made up at very little outlay in money or labor and will make square bends very neatly in copper bars up to ¼x4-in. section. An arbor press is usually available and is used to supply the pressure for bending the busbar.

•

White paint on walls doubled illumination and increased accuracy at the Wenczel Tile Co., Trenton, N. J.

•

Combination Melting Pot and Ladle

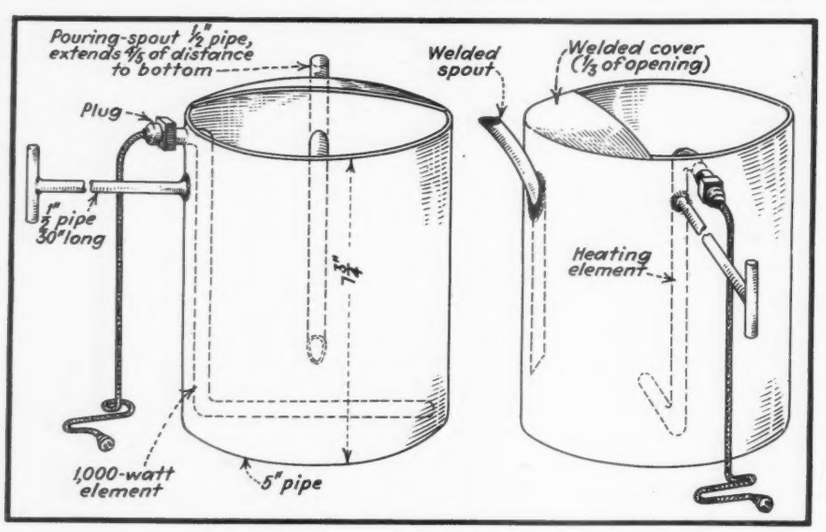
WM. B. CONE, *Chief Electrician*
The Shevlin-Hixon Company
Bend, Ore.

For use around the repair shop, and in babbitting small- and medium-sized bearings the melting pot shown will be found very handy. The pouring spout extends down close to the bottom of the pot, insuring clean metal. The pot holds approximately 24 lb. of babbitt.

When babbitting bearings, two 500-watt strip heaters are placed or clamped directly onto the shaft at the bearing housing in order to heat both.

Just sufficient current at low voltage is kept on the pot at all times to insure molten metal is always available on short notice.

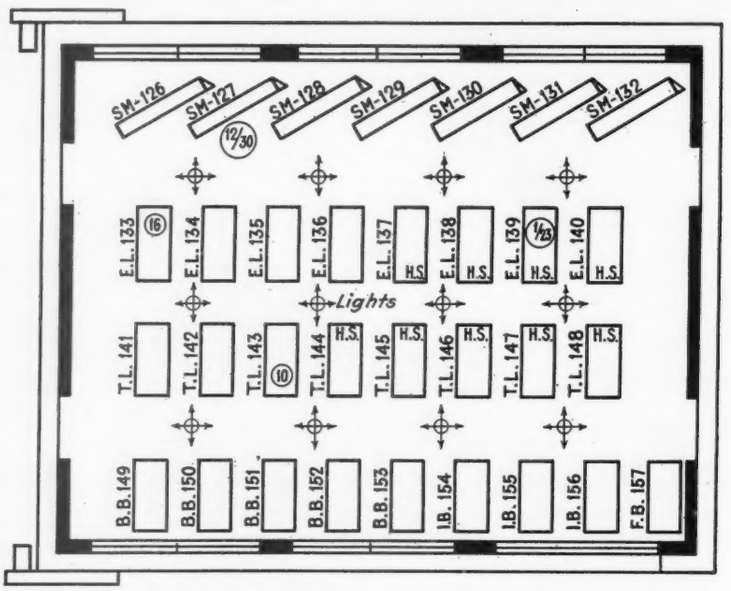
With the exception of the heating element, which is not at all expensive, the cost of such a pot is negligible. The heating element has a maximum temperature of 950 deg. Fahrenheit.



Visual Method of Recording Maintenance

JOHN A. HONEGGER, *New York*

In a manufacturing organization consisting of many departments, where numerous machines are continually in operation, the maintenance problem is quite a factor.



To be able to get a bird's-eye view of this situation makes for better control and more efficient operation of the maintenance organization. It also strikingly sets forth equipment which is either worn out or otherwise obsolete.

To obtain such a view the writer developed the following method.

A set of 3x5-ft. pivoted boards, similar to a multiple display board, was employed. On both sides of each panel were glued plant layout drawings, one for each department, giving the location of each machine or branch of service.

Different colored celluloid thumb tacks were then obtained. Upon these were written the following symbols:

1. (12/24) Red—Safety guards or devices out of order
2. (1/16) Green—Power transmitting mechanism out of order
3. (17/18) Yellow—Motive power out of order
4. (12/16) Light Blue—Parts on order from vendor
5. (1/30) Royal Blue—Parts being made in plant
6. (4/16) Tan — Obsolete equipment
7. (3/29) Pink—Being overhauled
8. (4/30) Orange — Bearings burned out
9. (3) Black number on white background—Employee's number.

When a breakdown or service order arrives in the maintenance department a clerk classifies it according to the foregoing categories and selects a tack with the proper symbol, places the date upon it, and sticks it into the proper department layout in the space occupied by the machine or equipment concerned.

As the status of the service or breakdown changes, the clerk either adds additional tacks or replaces the present ones.

If a service employee is at work on the machine a tack with his number is placed on or near the machine.

As the various service employees move from one department or machine to another they report to the clerk who then transfers their numbers accordingly.

Through this visual method of

control the following data are always available:

1. Location in the plant of each maintenance man.
2. Status of maintenance on each machine.
3. Length of time a machine is "out."
4. Number of machines out of order by departments and in the entire plant.
5. Ratio of maintenance men to member machines out of order.
6. Machines not properly guarded for safety.
7. Source of delay in completing servicing of a machine.

•

IF YOU ARE TOO GOOD TO CLEAN THIS MACHINE YOU'RE TOO GOOD TO WORK HERE read plates attached to every machine at the Boyar Schultz Corp., Chicago. Results: a model machine shop; fewer rejects for inaccurate work.

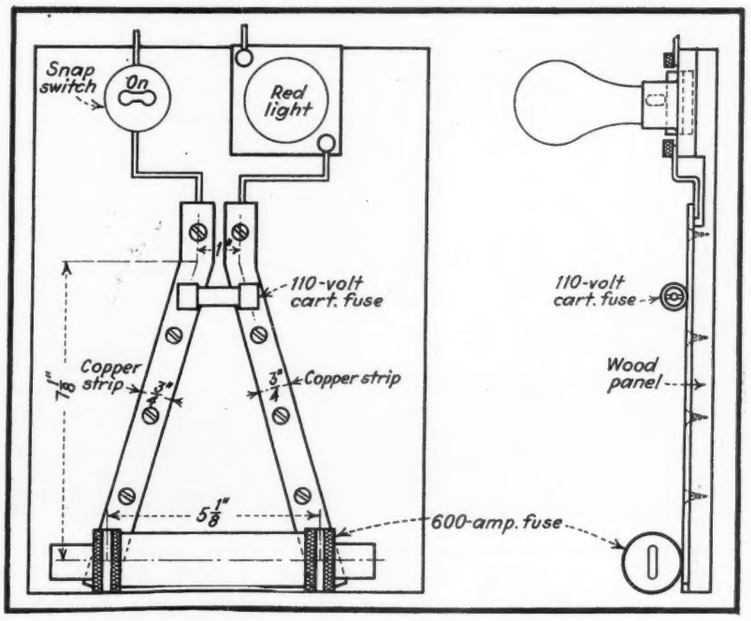
•

Handy Fuse Tester Saves Time

HAROLD C. ROSI, *Master Mechanic Anaconda Wire and Cable Company Pawtucket, R. I.*

One of the handy items of equipment in the electrical department or repair shop is a device for testing quickly fuses of the sizes commonly used around the plant.

The sketch shows details of a fuse tester that we use. It is easy to make up and has saved us a good deal of time.



Proper Storage for Paints and Oils

A. L. SAINT, *Purchasing Agent The Hoosier Manufacturing Company, New Castle, Ind.*

Paints, enamels, oils, and other flammable materials are stored on convenient racks in a separate, fireproof building a short distance away from our main factory. This building is always heated to a uniform temperature, keeping the finishing materials in proper condition for immediate mixing and preparation for spray booths throughout the plant. An experienced man mixes all finishes in this building and delivers them daily to the different departments.

This method of handling finishing materials eliminates the fire hazard present when paint is stored in the factory, and insures a more uniform mix for every purpose. Also, it saves a great deal of time that would be lost if each paint-using department drew its supply from a cold storehouse and had to wait for the material to become warm enough to mix and use.

•

To Restore D.C. Polarity Quickly

W. M. GRAY, *Berkeley, Calif.*

Frequently the polarity of a d.c. machine becomes reversed and it is necessary to flash the fields in order to restore the proper polarity. If the wiring is in conduit it requires time and labor to get to the generator terminals, which have to be untaped and disconnected, in order to apply the external power.

This work can be avoided by cutting in all of the resistance in the field rheostat and then putting the external direct current across the rheostat terminals. The resistance in the field rheostat is usually fairly high; so most of the applied current flows through the shunt fields, producing the desired effect. Since rheostat terminals are commonly exposed, no trouble is encountered in getting to them. Restoration of the proper polarity can be accomplished in this way quickly and without disconnecting any wiring.

SPECIAL NOTICE

$10 will be paid for the best Operating Short submitted during the month of April. The Editors are the judges. Other Shorts accepted will be paid for at attractive space rates.

•

Now They Lubricate by Schedule

An Eastern textile mill had trouble with rayon spindles sticking and causing belts to slip on pulleys. This resulted in serious production loss as well as rapid wear of belts and pulleys.

They blamed the spindle oil but found by test that it met every specification for carbon, distillation, dirt, and sediment. They then made photomicrographs and learned that the oil on the spindles was mixed with bits of thread.

The spindles revolved so rapidly they created a suction which drew threads into the bearings, gumming the oil and creating friction.

Sealing the bearings involved excessive cost. It was decided to establish a definite cleaning and relubricating schedule, going over each bearing affected once a week. The cleaning is done quickly by dipping the parts in a cleaning solution.

Power Transmission Lubrication

Far too much of the power sent out to do work never gets to the job. Reason, friction and wear. Answer, right lubrication

WILLIAM STANIAR
Mechanical Power Engineer
E. I. duPont de Nemours & Co., Wilmington

RELIABILITY, power economy, and low maintenance costs are essential features of mechanical power transmission. Regardless of the type of equipment employed, with a few exceptions, these features will not be in evidence unless the correct lubricant is applied in the proper manner.

Proper lubrication minimizes wear, because the frictional surfaces of the contacting parts are separated from one another by a fluid film that is constantly replenished by the carrying action of the moving parts. With an oil film separating the working or frictional surfaces, wear and power waste are reduced to a minimum unless abrasive impurities get into the oil.

Fluid for Solid Friction

The oil film reduces power losses by substituting fluid friction for solid friction. Such reduction results in the effective utilization of power that would otherwise be expended in the gradual destruction of the working parts. Obviously, maintenance costs and power consumption of mechanical power transmission equipment are strongly influenced by the manner in which it is lubricated.

Applications of mechanical power transmission equipment fall into systems—the flexible and the rigid. The flexible system comprises: (1) Group shafting and belting; (2) group shafting and chain; (3) direct chain connection; (4) multiple V-rope drives; (5) belt drive with pivoted motor; (6) variable-speed transmissions. The rigid system comprises: (1) Direct connection to motor; (2) worm gear reduction units; (3) spur gear reduction units; (4) herringbone gear reduction units; (5) motorized reduction units; (6) open gearing.

With the exception of the multiple V-rope, pivoted motor, and direct-coupled installations, all drives in both the flexible and rigid systems require lubrication, differing only in type of lubricant and manner in which it is applied.

Bearings of all types, friction clutches, and loose pulleys are the principal items in group drives employing shafting and belting that re-

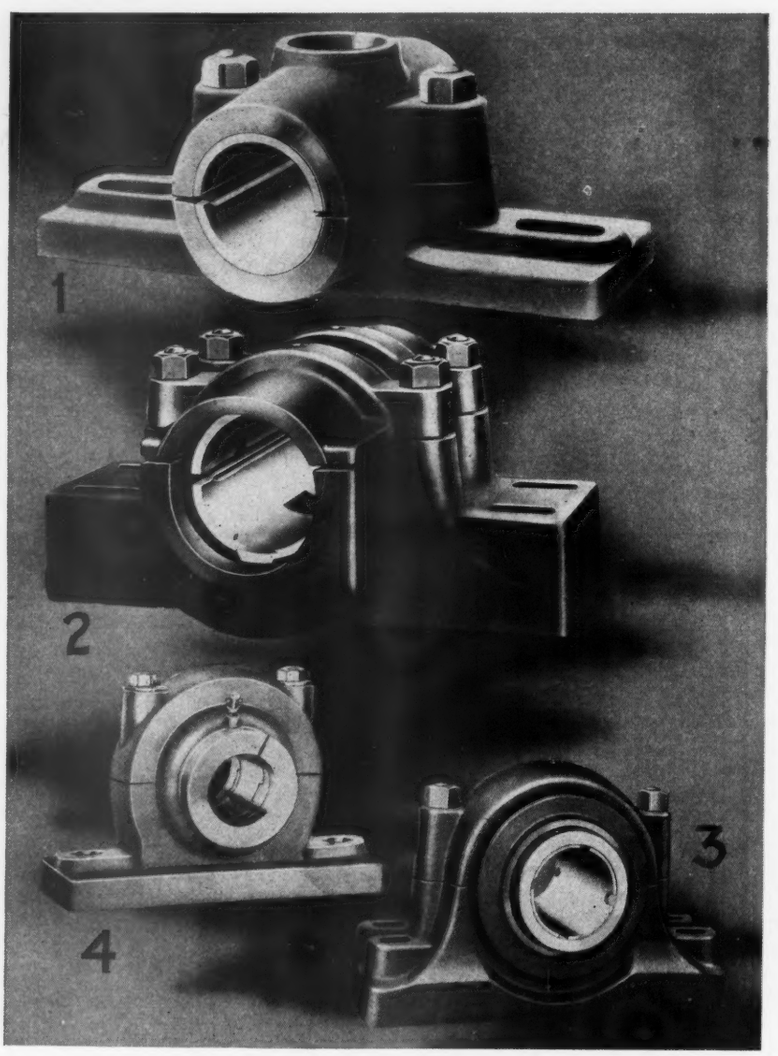


Figure 1. Hand-lubricated, rigid, babbitted, pillow block. Figure 2. Self-oiling —ring, collar, or capillary—rigid, babbitted pillow block. Figure 3. Solid roller- or ball-bearing pillow block. Figure 4. Flexible-roller pillow block

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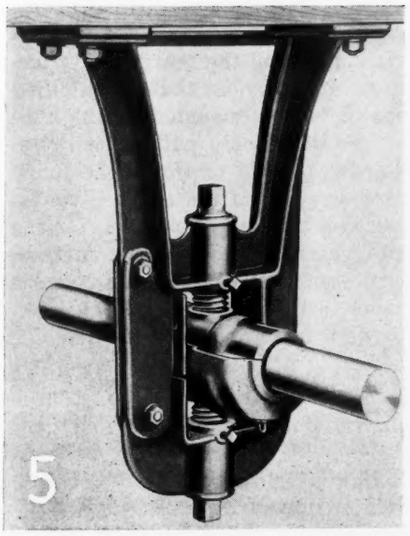
All of the material to be presented in this series of articles has been taken from the manuscript of a new handbook on mechanical power transmission which is now being prepared by the author and will be published by the McGraw-Hill Book Company.

The author is indebted to L. G. Benton, Lubrication Engineer, E. I. duPont de Nemours & Company, for the specification of lubricants and methods of application discussed here.



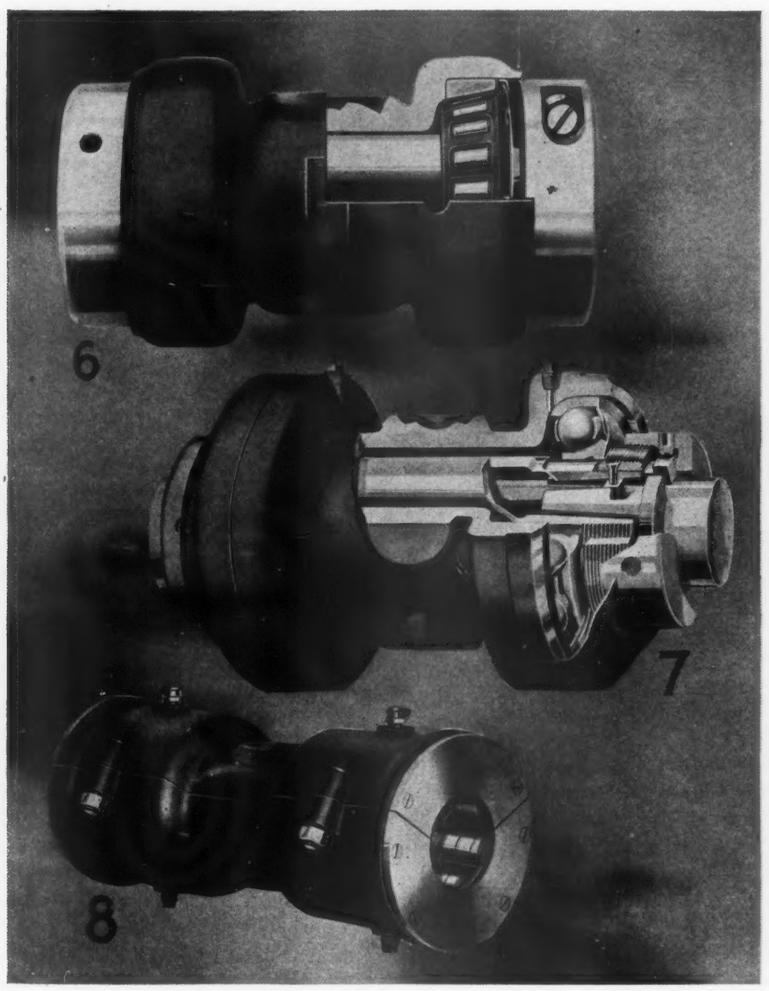


Figure 5. Self-oiling—ring or capillary—babbitted hanger. Figure 6. Solid-roller hanger bearing. Figure 7. Ball hanger bearing. Figure 8. Flexible-roller hanger bearing

quire constant and efficient lubrication for best operating results.

Irrespective of type, the bearings employed on head-, line- or countershafts should be so lubricated that there is a constant separation preventing metal-to-metal contact. This film should be a correctly selected oil or grease with characteristics suited to the methods of application and viscosity suited to the service, so that it may function over a long period of time.

Bearing loads and temperatures should be given primary consideration, because if the effect of these factors on the adsorbed film becomes excessive, bearing failure will occur. The effect of high temperature on all oils or greases is to decrease viscosity. With any oil there is a temperature, depending upon the bearing load and speed, beyond which satisfactory lubrication becomes impossi-

Table I—Lubrication of Groupshaft Bearings

(Temperatures not above 150 deg. F.)

Bearing Type	*Shaft Diam., Inches*	*Speeds, R.p.m.*	*Character of Load*	*Lubricant*	*Method of Application*	*Shaft Designation*
Hand-lubricated, rigid, babbitted	1 to 2	100 to 200	Steady	Oil 200-300 sec. S.U.V. 100 °F.	Wick or S.F. cup	Head or line
	2¼ to 4	25 to 100	Steady	Oil 250-500 sec. S.U.V. 100 °F.	Wick or S.F. cup	Head or line
	4¼ to 8	5 to 50	Shock-steady	No. 2 cup grease	Compression cup or pressure fitting	Head
Self-oiling, rigid, babbitted, ring, collar or capillary	1 to 2½	100 to 400	Steady	Oil 150-200 sec. S.U.V. 100 °F.	Maintain oil level	Head or line
	2¼ to 4	50 to 300	Steady	Oil 250-500 sec. S.U.V. 100 °F.		Head or line
	4¼ to 6	25 to 150	Shock-steady	Oil 280-500 sec. S.U.V. 100 °F.		Head
	6½ to 10½	5 to 50	Shock	Oil 500-750 sec. S.U.V. 100 °F.		Head
Solid roller or ball pillow blocks	1½ to 2½	100 to 750	Steady	Grease—not less than 320 Penetrometer number: soda-soap base	Pressure fitting. Bearing not more than ⅓ full	Head or line
	2¼ to 3½	50 to 500	Steady			Head or line
	4 to 5	25 to 300	Shock-steady			Head
Flexible roller pillow block	1½ to 3½	100 to 500	Steady	Oil 265-340 sec. S.U.V. 100 °F.	Maintain oil level not more than ¼ full	Head or line
	4 to 5	25 to 300	Shock-steady	Oil 465-750 sec. S.U.V. 100 °F.		Head
Self-oiling, babbitted hanger bearings, ring or capillary	1 to 3	100 to 400	Steady	Oil 150-200 sec. S.U.V. 100 °F.	Maintain oil level	Line
	3¼ to 5	50 to 250	Steady	Oil 250-500 sec. S.U.V. 100 °F.		Line
Solid roller or ball hanger bearings	1½ to 2½	100 to 500	Steady	Grease not less than 320 Penetrometer number: soda-soap base	Pressure fitting. Bearing not more than ⅓ full	Line
	3 to 4	50 to 350	Steady			Line
Flexible roller hanger bearings	1½ to 3½	100 to 400	Steady	Oil 265-340 sec. S.U.V. 100 °F.	Maintain oil level not more than ¼ full	Line
	4 to 5	50 to 300	Shock-steady	Oil 465-750 sec. S.U.V. 100 °F.		Line

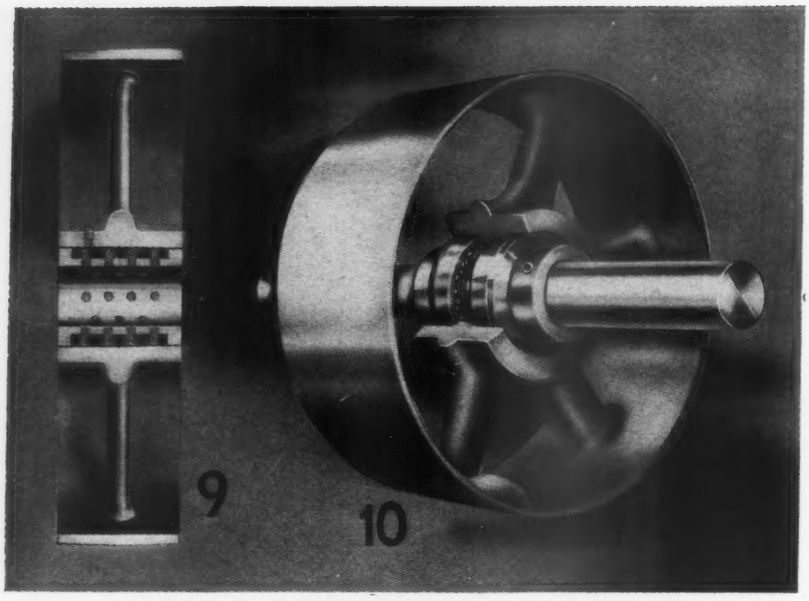


Figure 9. Loose pulley with capillary-type, self-oiling bushing. Figure 10. Ball-bearing, loose pulley bushing

ble. Proper bearing lubrication, therefore, depends on securing a balance between the film-forming factors of oil wedge, speed, adsorption, viscosity and lubrication value, and the film-destroying effects of pressure and temperature.

What Proper Lubrication Is

Without going into the complicated theory of bearing lubrication it can be said that with proper lubrication the journal floats on an oil film under a hydraulic pressure that is built up by rotation and controlled to a considerable extent by the method of introducing the lubricant.

The most important consideration in this respect is the design and finish of the oil grooves, since they must bring in the oil in such a manner as to start formation of the oil wedge. The degree in which a perfect separating film is built up depends to a greater extent on the strength of the oil film. At high velocities it is most important to keep the internal friction of the lubricant as low as possible. It follows that the most efficient lubricant is one that has the lowest viscosity and at the same time has sufficient film strength and body to protect the bearing from journal contact.

In determining proper lubricants for the bearings of group shafting and belting drives, consideration of high temperatures can be neglected since 110 deg. F. is seldom exceeded. Therefore selection is usually based on pressure, speed, and type of bearing employed.

Bearings for head-, line- and countershafting may be either of the babbitted or the anti-friction type, the design of each depending on load, speed, and operating conditions. Proper lubricants and methods of application for bearings in service of this character are shown in Table I. Types of bearings used are illustrated in Figures 1 to 8.

Lubrication of Loose Pulleys

The loose pulley of a tight-and-loose-pulley combination for power application control is frequently the source of high maintenance cost and continuous trouble, due to the use of the improper type of shaft bushing and neglect of lubrication. Loose pulleys present a problem of bearing lubrication in which the shaft is stationary and the bearing is in motion. It is obvious that, when oiling appliances are mounted on the hubs of revolving loose pulleys, centrifugal force tends to throw the lubricant away from the areas to be lubricated. This problem of forcing oil or grease to the bearing surfaces has been solved to a considerable extent by the use of improved bushings for loose pulleys.

Bushings in Modern Designs

In its common form, the cast-iron loose pulley is either plain bored or equipped with a bronze bushing lubricated by means of a pressure grease cup. Such a grease cup is usually inaccessible, which causes neglect and results in rapid wear of the bushing. Bushings of this type should be employed only on low-powered drives and where the loose pulley revolves for short periods.

Modern loose pulleys are equipped with self-oiling bushings of the capillary type, as shown in Figure 9, or with anti-friction bushings, of which one type is shown in Figure 10. Bushings of these types should be employed where frequent shifting is necessary, where the belt runs over the loose pulley for long periods, and where the drive is inaccessible. With either of these bushings one filling of lubricant will be sufficient for a long period of operation.

Table II gives the lubricants and methods of application recommended for loose pulley bushings.

(Lubrication of friction clutches and other equipment will be discussed in a second article, scheduled for early publication.—Ed.)

Table II—Lubrication of Loose Pulley Bushings

Type	*Capacity, Horsepower*	*Loose Pulley Operation*	*Shifting*	*Lubricant*	*Method of Application*
Bronze bushed or plain cast-iron, bored	1 to 5	Short periods	Infrequent	No. 2 cup grease	Spring pressure cup
Capillary bushing	1 to 15	Fairly long periods	Frequent	Oil 250-500 sec. S.U.V. 100°F.	Grease gun, or by hand
Ball-bearing bushing	1 to 50	Long periods	Frequent	Grease not less than 320 Penetrometer number: soda-soap base	Grease gun
Roller-bearing bushing	1 to 50	Long periods	Frequent	Grease not less than 320 Penetrometer number: soda-soap base	Grease gun

Check Those Flow Meters

They play a large part in determining operating costs, should therefore be regularly serviced, periodically checked, for accuracy

E. B. BOSSART
Mechanical Engineer, Bailey Meter Company
Cleveland

FLOW METERS for the measurement of steam, gas, compressed air, water, and other liquids are an admitted necessity in the efficient operation of modern factories. They furnish information for allotting the charges for services against various departments and processes, and because of their importance in determining operating costs and procedures it is highly desirable that they be checked for accuracy at regular intervals and that they receive proper attention when discrepancies first develop.

The first step is to place a capable man in charge of the work. He should be made responsible not only for the accuracy of meter readings in terms of pounds or gallons, but also for the calculation, tabulation, and graphic presentation of operating results to the management.

Accurate information of this kind removes the veil of personal prejudice and uncertainty regarding the efficiency of this or that machine or process. One of the greatest lost opportunities that any manufacturing establishment can suffer is the lack of vital information resulting from inattention to metering equipment that is already installed and could be of efficient service.

Check Meters Regularly

The flow meter of today is a sturdy and reliable piece of equipment when properly installed and maintained. It should, however, be inspected and checked at regular intervals.

A good day-by-day check can be obtained by comparing meter readings. For example, total boiler output as indicated by steam meters on the boilers should agree with total steam consumption as shown by distribution meters; it should also check with total feed-water meter readings after allowance is made for such factors as boiler blowdown and saturated steam to auxiliaries.

This arrangement is frequently used by vendors and purchasers of steam—the steam company metering at its end of the line and the purchaser checking with his own meters. A large oil refinery buys over three hundred million pounds of steam per month by this method, and a comparison between the two sets of meter readings shows an average difference of less than 0.05 per cent.

The most definite check for a steam meter is the so-called "weighed water test" in which steam measured by the meter is passed through a surface condenser or its equivalent and is then weighed in open tanks on platform scales. Although this test gives the ultimate answer regarding meter accuracy, it is difficult to perform in industrial practice because of the lack of proper piping arrangement and weighing equipment. It is used extensively, however, in central station practice to check not only meter accuracy, but also turbine performance.

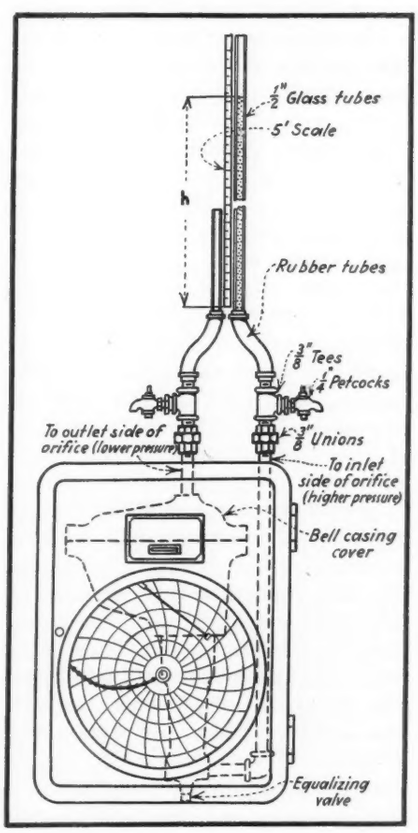


Figure 1. Parts for a water-column calibration outfit can be found in any factory stockroom

Care must be taken in attempting a weighed water test to be sure that it is of sufficient duration to minimize any errors resulting from time discrepancies in starting and stopping the tests. This is particularly true if the only way of obtaining a weighed water test is by weighing water to a boiler. It has been found that even with the water brought to a string on the gage glass a difference in the rate of steaming, rate of feed, and steam pressure will have a decided effect upon the volume occupied by steam below the water level.

If the Meter Is in Error

Conditions should be carefully noted at the beginning of the test and duplicated as nearly as possible at the end, and even then it is necessary that the amount of water evaporated during the test be at least twice the total water capacity of the boiler. For instance, if the water space of a boiler holds 30,000 pounds, then at least 60,000 should be evaporated during a meter calibration test; if the boiler is steaming at an average rate of 10,000 pounds per hour, the test should last six hours.

If the meter is shown to be definitely in error by either of the previously mentioned methods of checking, the maintenance man should check over the mechanical

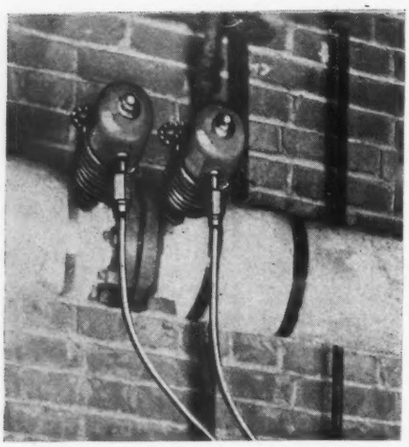
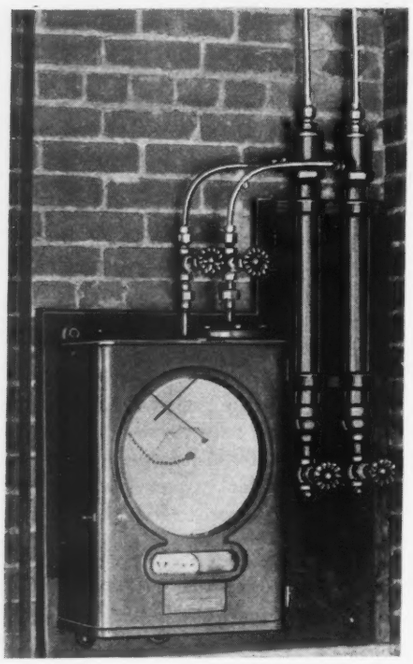


Figure 2. A typical steam flow-meter installation with settling chambers. Note minimum of fittings—bends being made instead in the copper tubing itself, reducing the possibility of leaks



mechanism, making sure that pen tension is not too great and that there is no undue friction.

He should be sure that wiring and connections in an electrically operated meter are properly made and of sufficient size to carry the required current. It is also well to check voltages. Most electrically operated flow meters, although compensated for voltage variations within certain ranges, serve best when operated at specified voltage.

For meters using synchronous motors to drive chart clocks and integrator devices, frequency must be accurately regulated.

After carefully checking mechanical mechanism and electrical connections, it is well to make sure that correct chart and integrator factors are being used.

Meters Must Be Clean

If the meter has been in service for six months or more without having been cleaned, the manometer should be opened up and all grease or sediment removed from the float or bell and other working parts. The cleaning of parts and manometer chambers can best be accomplished by the use of high-gravity gasoline, boiling in water, scrubbing with cleaning compound, or scraping with a dull scraper if necessary.

Quantity and cleanliness of the mercury play an important part in the accuracy of flow meters. Both factors should be checked when the manometer is opened. Quantity may be checked by weighing it on a balance scale, by measuring the mercury level with a depth gage, or by other methods indicated in the instructions furnished with the meter.

The Matter of Mercury

The necessity for thoroughly clean and completely distilled mercury is not always properly appreciated. Dirty or badly amalgamated mercury causes sluggish meter operation by its tendency to "hang up" on manometer walls, floats, bells, standpipes, and other parts.

If the flow mechanism is thoroughly cleaned and filled with mercury purchased from a reliable manufacturer of flow meters, no trouble need be expected from this source. However, if the mercury has become dirty through service, or if additional mercury has been secured from a questionable source, it should be thoroughly purified before use. This operation is properly a job for the plant chemist and should include filtration, washing by prolonged agitation with mercurous nitrate solution to which a little nitric acid has been added to prevent the formation of an insoluble basic mercurous nitrate, and finally distillation.

A worthwhile test to determine the condition of the meter itself (secondary element) is the zero check. This check can be quickly made by closing the valve in one of the connecting lines from the orifice and by opening the meter bypass valve to equalize pressures on either side of the manometer. Under these conditions the recording pen should register zero in a few seconds after the valve is opened. If not, the trouble may be the result of: (1) Grease or sediment in the flow mechanism: (2) dirty mercury; (3) friction in the meter mechanism; (4) incorrect pen setting; (5) air trapped in the flow mechanism.

If the pen registers below zero, or if the mechanism strikes the zero stop sharply when the pressures are equalized, check for a loss of mercury.

Water-Column Calibration Test

After a meter has been disassembled and reassembled, its accuracy of calibration should be checked by a water-column test. All flow meters are calibrated to give a maximum chart reading under a differential pressure, H, of a certain number of inches of water, which varies with the type of meter and the manufacturer. Orifices used with the meters are designed to produce a differential pressure at the capacity marked on the orifice or on the data sheets furnished with the meters.

The purpose of checking the calibration of the flow recorder is to ascertain if the various chart readings correspond to differentials

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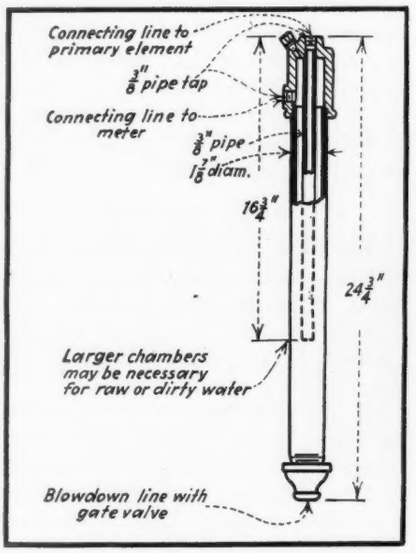

Connecting line to primary element
3/8" pipe tap
Connecting line to meter
3/8" pipe
1 7/8" diam.
16 3/4"
24 3/4"
Larger chambers may be necessary for raw or dirty water
Blowdown line with gate valve

Figure 3. Detail of settling chamber designed to trap sediment outside of meter mechanism

In Paralleling D.C. Generators

Division of load, whether the drive is by diesel engine, steam engine, or turbine, depends primarily upon voltage and speed regulation

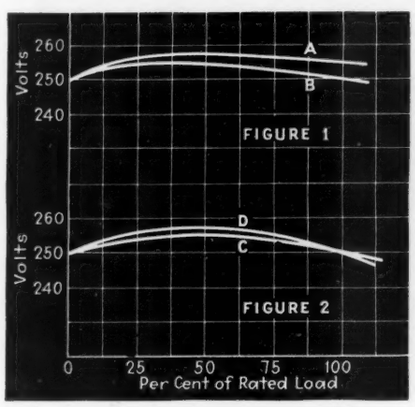
J. S. NEWTON
Power Engineering Division
Westinghouse Electric and Manufacturing Company
East Pittsburgh, Pa.

FREQUENTLY the plant engineer is confronted with the problem of making a diesel-engine-driven d.c. generator operate in parallel with an existing diesel or steam-engine-driven generator, or with the compensated type of machine used in large motor-generator and turbine-driven sets.

When purchasing a diesel-driven d.c. generator set it is common practice to buy the complete unit from the engine builder, who sublets the contract for the electrical equipment to an electrical manufacturer. If the customer is supplementing present plant capacity with a new unit, he specifies the no-load and full-load voltages of the present equipment, and states that parallel operation with certain existing generators is required.

For Proper Load Division

The electrical manufacturer designs the d.c. generator for the specified voltages when it is driven by a prime mover having the speed regulation guaranteed by the engine builder—usually 5 to 7 per cent droop from no load to full load. After testing and adjusting, the generator is shipped, sometimes to the engine builder and sometimes directly to the customer. In either event final adjustments have to be made at the customer's plant, since parallel operation is greatly affected by the lead resistance from each machine to the switchboard and the voltage regulation of each machine as measured at the switchboard.



Figures 1 and 2. The first requirement for satisfactory parallel operation of d.c. generators is that they have substantially the same voltage regulation curves

Most d.c. generators used for supplying electrical energy for plant lighting and driving machine tools are compound wound. Since this type of machine is more difficult to adjust for parallel operation than a shunt generator, this discussion will be confined to compound-wound machines.

The first requirement for satisfactory load division is that the generators to be paralleled have as nearly the same voltage regulation curve as is possible. Referring to Figure 1, it is obvious that machine *A* will carry more than its proportionate share of the total load because its voltage at full load is 255 volts, whereas the voltage of machine *B* is 255 volts at only one-half load.

Same Voltage Curves Essential

Before these machines can be expected to divide the total load proportionately, adjustments must be made so that each has approximately the same voltage at the same percentage of load. It is also essential that the shape of the voltage regulation curve for each machine be similar.

It will be noted from Figure 2 that, although each machine has the same no-load and full-load voltages, the voltages at intermediate loads are not the same. Machine *C* has a half-load voltage of 255, whereas machine *D* has a voltage of 255 volts at three-fourths load. Actually, if these two machines were connected in parallel, machine *C* would not be operating at half load and machine *D* at three-quarters load because of the paralleling effect of the equalizer connection.

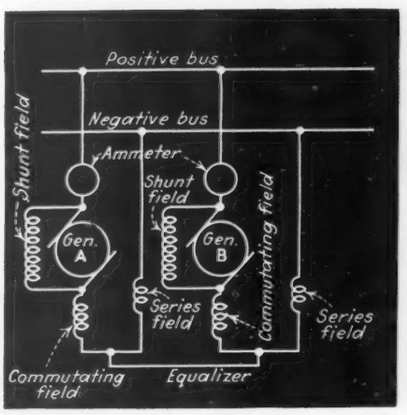


Figure 3. Schematic diagram of connections for parallel operation of two compound-wound generators with commutating poles

The reason for this will be explained in a later paragraph. However, the effect of the equalizer connection is not sufficient to permit good parallel operation if the voltage regulation curves are too dissimilar. Methods of changing the shape of that curve will be discussed later.

When a d.c. generator is operated at constant speed the voltage is a function of the strength of the main field. In a compound-wound generator the main field is composed of a shunt field and a series field. The shunt field strength is nearly constant at all normal loads, but since the other field is in series with the armature, its strength increases

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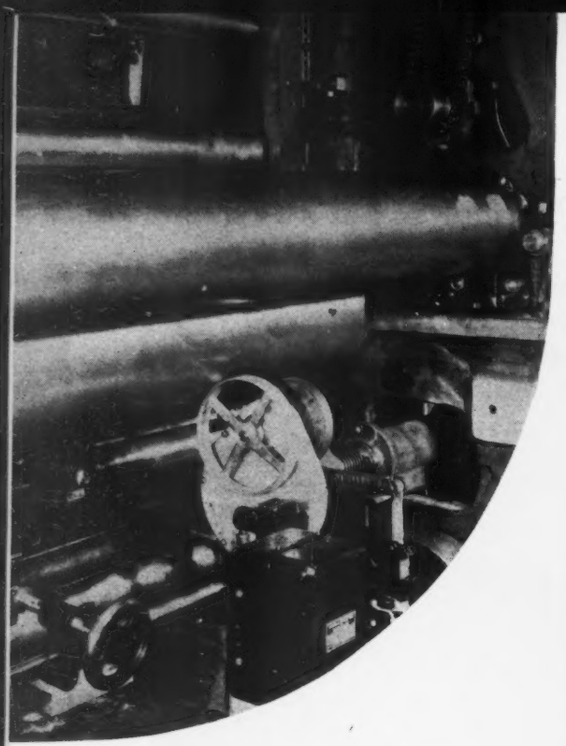
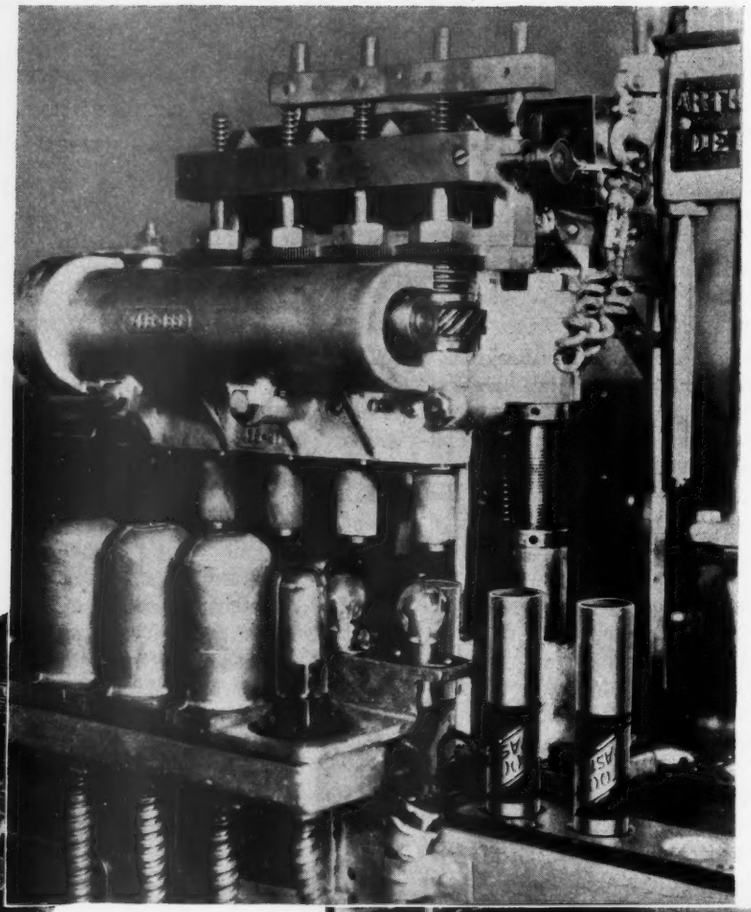


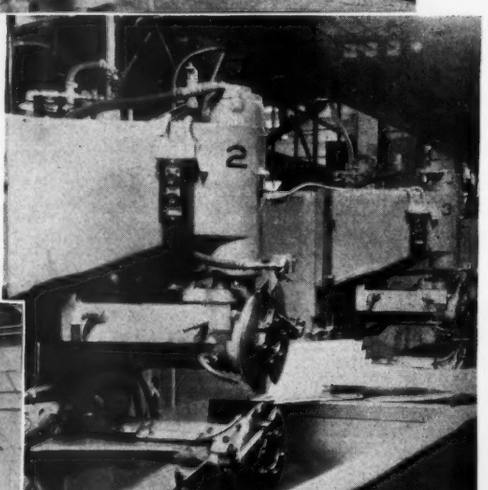
When the paper breaks or runs out a light beam initiates action to pull back the wheel of this footage recorder on a paper winder

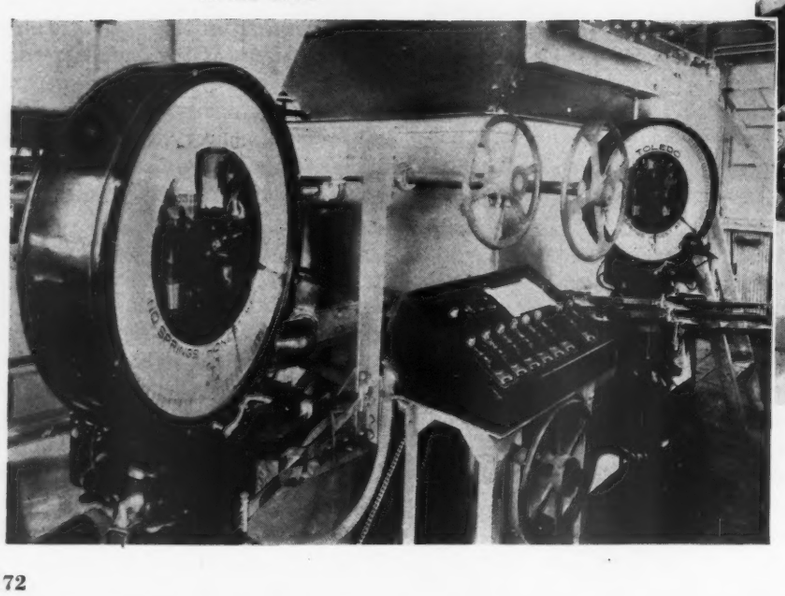


Toothpaste tubes must be crimped squarely with the label. Phototubes see that this order is obeyed

Small targets on the tote boxes determine when and where they will be shunted off the conveyor

A phototube says when. Each scale controls the weights of three ingredients in every batch. The selective control board is in the center





Grid controlled tubes permit these machines to operate either as seam or spot welders. These tubes can pass 19,500 amperes at 1½ volts for 0.016 seconds

What Electron Tubes Are Doing

Controlling motor speeds, counting objects, matching colors are among the important jobs difficult if not impossible to accomplish without their help

R. H. ROGERS
Industrial Engineering Department
General Electric Company, Schenectady, N. Y.

LAST month* some of the characteristics of electron tubes and their method of functioning were discussed. How are these characteristics put to practical use? Applications that do not depend upon phototubes to initiate action will be considered first.

Accurate speed control of motors is often highly important. The Thyratron tube is much used for this purpose, serving as a rectifier to deliver direct current to the armature or field circuit of a d.c. motor. The output of the tube, and, therefore, the speed of the motor, is controlled by a small reactor with a movable core that controls the grid potential.

One such application is on processing machine drives in the rubber and textile industries. As many as six machines may be operating in series, handling a long piece of material. They are driven by d.c. motors, controlled as a fleet by the adjustable-voltage or Ward Leonard system. Each motor has its own Thyratron tubes for field excitation.

Machine Speeds Synchronized

As the cloth leaves each machine it passes under a floating roll, whose up-and-down movement is transferred to the core of the reactor in the grid circuit. If one machine tends to run faster or slower than the others, the floating rolls move slightly and the machine speeds are quickly synchronized.

Heretofore these units in the range were regulated by field rheostats actuated mechanically by "gate" rolls that moved through a considerable distance and had to overcome the friction of the rheostat. The apparent lack of movement of the rollers with the tube control indicates the fineness of the non-lagging, non-hunting control.

*"Let's Look Into Electron Tubes," March, page 123.

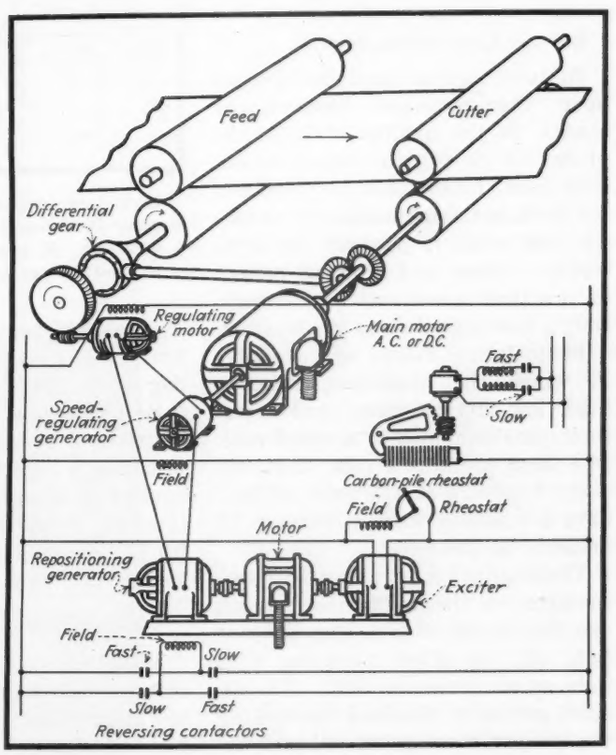
Another motor control application is found in wire drawing. Here the Thyratron tubes supply armature current to the reel motor. Copper wire being drawn to a small diameter at several thousand feet per minute passes under a floating pulley held down by a spring. Any movement of the pulley moves the core of a reactor in or out, slowing down or speeding up the reel motor. Tension in the wire is thus held constant by the adjustable spring on the pulley.

The principle of controlling large blocks of alternating current without opening or closing the circuit, by means of a small amount of direct current from a tube, is applied in sign and theatre lighting. A saturable reactor is placed in the a.c. circuit to be controlled. The d.c. winding of the reactor is connected with the Thyratron tubes.

When no direct current is applied, the impedance of the reactor reduces the alternating current to a negligible value. When direct current is applied, the impedance of the reactor becomes less and the alternating current flow increases. One-fourth watt in the tube grid system can control 50 kw. in the a.c. line—200,000 amplification.

By using a series transformer in place of a saturable reactor, the action can be controlled precisely in terms of cycles or half-cycles for time-on or time-off, and for volume of current. In one plant a battery of spot and seam welders with tube control is making 2,000,000 spot welds and 7½ miles of seam welds a week on thin, stainless steel. The same units make spot welds and seam welds simply by adjusting the off and on periods. Welds are made in 0.037-inch, 18-8 stainless steel with 1¼ volts, 19,500 amperes applied for 0.0166 second.

In X-ray examination of heavy



Arrangement of motor drives with photoelectric register control used on a cement sack tuber. The controlling tubes shown in the next illustration connect to the Fast or Slow contactors as required to reposition the web and regulate its speed

metal parts for flaws, especially in welded joints, a Kenotron tube supplies the high-voltage direct current for the X-ray tube. Some of the equipments for inspection of A.S.M.E. boiler code welds use direct current at 400,000 volts.

For charging batteries from an a.c. circuit, use is made of a Phanatron tube functioning as a simple rectifying unit. Recent developments have made it possible to make the tube all of metal except for small glass beads that are fused to a special alloy called Fernico (iron, nickel, cobalt) to provide the necessary insulation. Two tubes are equivalent to a 15-kw. motor-generator set and are each about the size of a 2-quart jar.

The high efficiency, especially at partial loads, light weight, and absence of rotating parts make a tube charger preferable to a motor-generator set. They are rated up to 75 amperes at 258 volts, or about 20 kw. Control of charging is maintained by a saturable reactor to which direct current is furnished by Thyratron tubes whose grids are controlled by a comparison circuit that provides the necessary standard of either voltage or current.

A Light Beam Does It

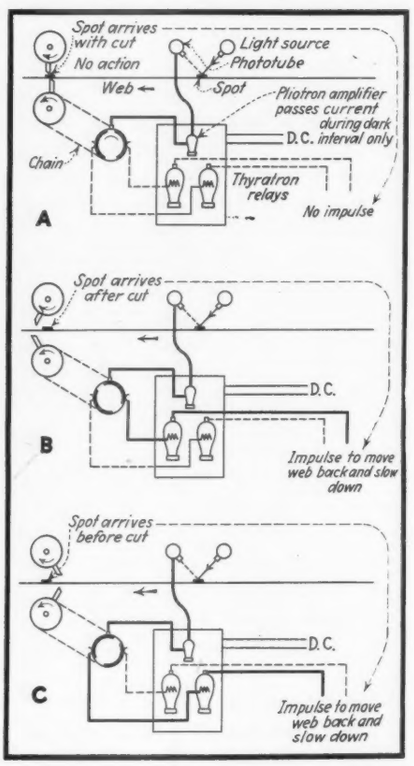
In tube applications that depend upon the presence, absence, or change in the quality of light the phototube is the initiating device. This tube alone cannot perform useful work, but amplification of its output has made it possible for it to control a great and growing variety of practical operations in industry. Only a few typical cases can be cited.

Photoelectric relays are available in which the phototube, Pliotron tube, low-current relay, and accessories are combined in a metal case. One form contains a relay that will carry 1 ampere at 115 volts. Others have a contactor that will carry 15 amperes at 220 volts.

These units are arranged with two contacts on the milliampere relay, one that closes with failing light or light off, the other operating with light on or increasing light. The desired action is obtained by making the proper connections. Light intensity at which the unit will operate is also adjustable.

Considering light-off applications, counting of parts passing on a conveyor is accomplished by directing the light beam across it. Every piece that passes cuts off the light, and the current then passed by the relay operates a counter.

By substituting the proper control device and aligning the light beam, any package or part that overhangs or is out of place can be made to stop the conveyor, to prevent damage.



How tube control on cement sack tuber functions when, *A*, spot arrives with cut; *B*, spot arrives after cut; *C*, spot arrives before cut

The same arrangement serves as a limit switch where use of a metal dog would not be practicable.

Soft materials, such as butter, are distributed to packing machines by breaking a light beam. The "slip" applied to enameled ware cannot be touched without blemishing the work; hence a light beam is used to control the oven conveyors.

Controlling Scales and Presses

With the help of a photoelectric relay, sensitive devices such as scales are made to shut off the flow of material when the desired weight is reached. No load is put on the pointer; it has to cut only a beam of light.

An interesting application has been made on a punchpress making can covers. At every dark interval caused by the passing of a cover from the die, a time-limit relay that is attempting to stop the press is set back to the start. Uninterrupted light for three punch cycles shuts down the press. Covers are punched at the rate of 150 a minute; hence lack of material or a cover sticking in the die will stop the press after 1.2 seconds.

Light-on applications of photoelectric relays are equally numerous. Paper is measured as it is being rolled by running it between a wheel and counter that registers the number of feet passed. A photoelectric relay is located so that when the paper breaks or runs out the light beam shines on the phototube, actuating a solenoid by which the wheel is drawn away from the roller, thus preventing false register.

Sorting Beans, Making Toast

Sorting and inspecting operations utilize changes in light intensity or color. In a Michigan plant about 50 tons of navy beans are sorted per day by a hundred units that remove the discolored beans, dirt, and stones. Each bean is subjected to a 1/30-second scrutiny by a phototube and is passed only if it is white.

White-enameled panels vary somewhat in whiteness, when compared closely with each other. The photoelectric color comparator is used for checking samples of refrigerator cabinet panels in order to maintain uniformity of color.

Browning toast to a uniform color is difficult, because the usual practice is to regulate the heat after the too-dark or too-light product has come through. By reflecting light from the toast in two zones before the final color is attained, the electric heaters can be regulated properly. One oven so equipped turns out 150,000 slices per 8-hour day. Before the color control was introduced it was necessary to retoast 8,000 slices and destroy between 2,000 and 3,000 slices per day.

Photoelectric pyrometers are used extensively in steel mills and other places where materials are heated sufficiently to give off light. A d.c. milliammeter is graduated in degrees to indicate the temperature of the luminous body viewed by the

(Continued on advertising page 92)

Costs Less to Brew Better

A Philadelphia brewery found it couldn't meet increased demand, spent $140,000 for new equipment, can now give its customers all the beer they want

NEW EQUIPMENT has been largely instrumental in permitting the Liebert & Obert Brewery Company, Philadelphia, to meet its rapidly increasing production schedule. With an excellent beer to offer, and an extensive advertising program to build up sales, the old brewery equipment would have been hopelessly unable to meet demand.

Of this modernization, costing in the neighborhood of $140,000, a large part has been for new power house equipment. It was installed not only to increase the capacity of the plant, but also to take advantage of the cheaper operating conditions to be had with modern apparatus. Also, with real engineering foresight, equipment has been purchased which allows the brewery to take advantage of lower electric rates and water charges.

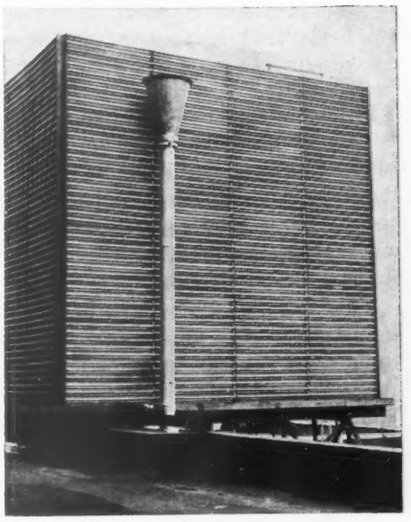
Its Own Transformers

In order to utilize untransformed primary power, two 100-kva. power transformers and suitable switching gear have been installed. By thus furnishing its own transforming equipment, the brewery is able to operate under a much cheaper electric rate than when it used the utility company's equipment.

Some idea of the saving in power costs that this new equipment makes possible can be shown by comparing the charges for the same monthly consumption. Assume a monthly demand of 100 kilowatts and an energy consumption of 5,000 kilowatt-hours. The charge for this set of conditions under the old rate would be $342.50. Under the new rate made possible by the brewery's transformer equipment, this charge amounts to $290—a monthly saving of $52.50, or over $600 per year.

High Power Factor

An additional saving in power costs resulted from the installation of a 100-ton ice machine. To drive this ammonia compressor, a 125-hp. synchronous motor is used. By properly regulating the field excitation of this machine, the power factor for the entire plant can be held near unity. As there is a penalty clause in the utility company's rate schedule for power factors less than 90 per cent, the maintaining of a high power factor pays appreciably in dollars and cents.



Cooling water is now recirculated. The saving will pay for tower, pumps, coils, and such inside of a year

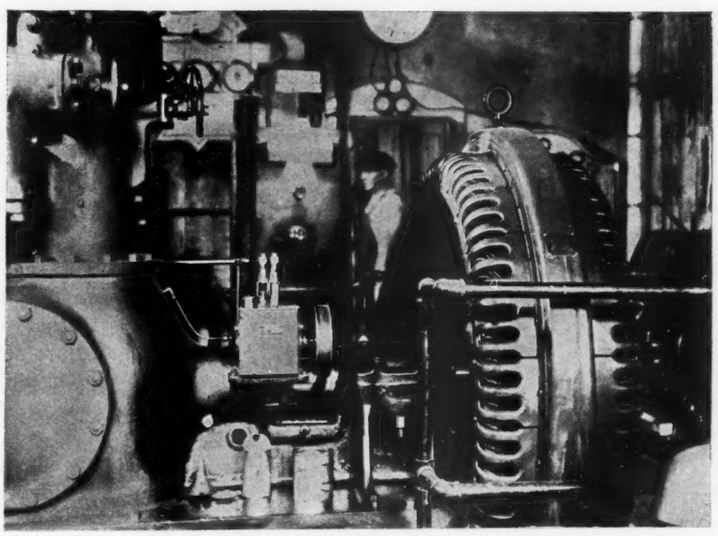
Making allowance for the increased production schedule, it is estimated that the power savings alone, resulting from the use of the above equipment, will pay for the new apparatus within one year.

For cooling purposes the brewery uses a considerable quantity of water. Previously, this water was taken from the city mains, and after being used was discarded.

To remedy this wasteful use of water, an entirely new cooling system has been installed. This equipment consists of a cooling tower, electrically driven water pumps, and new cooling coils. The saving resulting from the use of recirculated cooling water will more than pay for this new equipment inside of one year. In addition, the better cooling temperatures simplify and facilitate brewing operations.

Can't Live Without It

Without this economical equipment, the present production and price schedules of the brewery would be impossible. The savings clearly indicate the handicap that obsolete breweries are working under in present-day competition.



This is the 125-hp. synchronous motor that drives the ammonia compressor, keeps power factor up where it should be

Buy Light, Not Lamps

An incandescent lamp bulb, unlike soap and paper towels, is an energy-producing machine and should be bought on a performance basis

J. H. HOWARD
Secretary, Huntington & Guerry
Greenville, S. C.

PROBABLY no single item in our list of ordinary requirements is as little understood by the layman as the incandescent lamp bulb. And, sad to relate, the electrical department often knows little more about it than the purchasing agent.

This lack of understanding costs industrial plants millions of dollars each year. It has made it possible for unscrupulous makers of inferior lamp bulbs to sell their cut-price wares to otherwise shrewd buyers at prices slightly under those of good lamps when, if all the facts were dragged into the open, it would be apparent that the buyer would be losing money if he accepted the lamps as a gift.

The Proper Category

Lamp bulbs are somewhat peculiar in this respect—that the buyer often fails to place them in their proper category of plant equipment. What I mean is, if the buyer invests in a production machine for his plant, he is concerned with its efficiency and its freedom from maintenance expense. This machine is to convert raw material into finished product. To get high degrees of efficiency and ruggedness, the shrewd buyer will pay any premium that is necessary. If he buys any energy-converting machine, whether it be prime mover or secondary motor, he pays an increased price for the device with the better performance.

But when he buys the energy-converting device known as the "electric lamp" he is quite likely to forget the specifications to which he worked when buying his motors and looms. He classifies his lamps along with hand soap and toilet paper as necessary dead expense—to be bought as cheaply as possible.

It is too easy when buying lamps to feel that one is buying a filament

with an enclosing glass globe. That is not the case. What one *is* buying is *light*, and the bulb is merely the device for converting the electrical energy into the form desired. And as with the motor, the cost of the device is very small compared with the cost of the energy it is going to convert during its normal life. That is why efficiency is of prime consideration in the buying of lamps.

Will Last 1,000 Hours, If—

A 200-watt lamp costs the industrial owner, say, 50c. If the lamp is of a reliable brand and is burned at its rated voltage, it will last 1,000 hours. During this time it will consume 200 kilowatt-hours of energy. This cost to the average industrial plant is about $3.

Suppose the buyer can get a lamp for 42c. instead of 50c. thereby saving 8c. Suppose he avails himself of this bargain (?) and finds that the lamp is 10 per cent less efficient. During the life of the lamp he will pay $3 for energy but he will get only $2.70 worth of light from it, thereby losing 30c. This leaves a net loss of 22c. against the 8c. saving in the price of the lamp.

If only one lamp were involved, it would not be serious, but if the buyer has 1,000 outlets and burns his lamps 4,000 hours a year, the energy he pays for and loses in the inefficient lamps amounts to $300 per complete replacement, or $1,200 per year. Deducting the saving of 8c. per lamp in first cost, a total of $320, leaves a net loss for the year of $880.

This case is not an extreme one. Many lamps vary more than 10 per cent from the efficiency attained by the best makers.

Lamp Life and Lumen Output

The low efficiency, whose effect we have been considering, may be the result of manufacture in plants without adequate equipment, of carelessness in manufacture, or of inadequate inspection. The incandescent lamp is a sensitive device. When properly made and honestly rated it can be expected to give its rated output with rated consumption for about 1,000 hours. But if the voltage is increased to 5 per cent above normal, the life of the lamp is halved and its lumen output increased 20 per cent. If the voltage is lowered 5 per cent below normal, the life is increased 80 per cent and the light output decreases to 85 per cent of normal.

In spite of the amazing sensitivity of the electric lamp as evidenced by the figures in the preceding paragraph, lamps that have had inadequate or no inspection are being

offered by manufacturers and bought by bargain-loving users.

Low efficiency in a lamp may not be evidence of improper intent on the part of the maker. It may, as pointed out, be caused by carelessness, by lack of technical knowledge, or by poor equipment. Whatever its cause, it forces the user to pay for current from which he gets no light.

The Cheap But Costly "Gyp"

But the low-efficiency lamp with all its losses is less costly to the user than the "gyp" lamp, the misrepresented and mis-labeled lamp. It too is on the market, pushed by salesmen whose stories doubtless sound plausible to the purchasing agent who often is not a technical man.

Some of these representatives claim greatly increased length of life for their product. When this claim is made, just remember that if the circuit voltage is lowered slightly over 5 per cent the life of the lamp will be doubled, but its input will be 92 per cent of normal while its light will be only 83 per cent of normal. A little calculation will show it to be a poor investment.

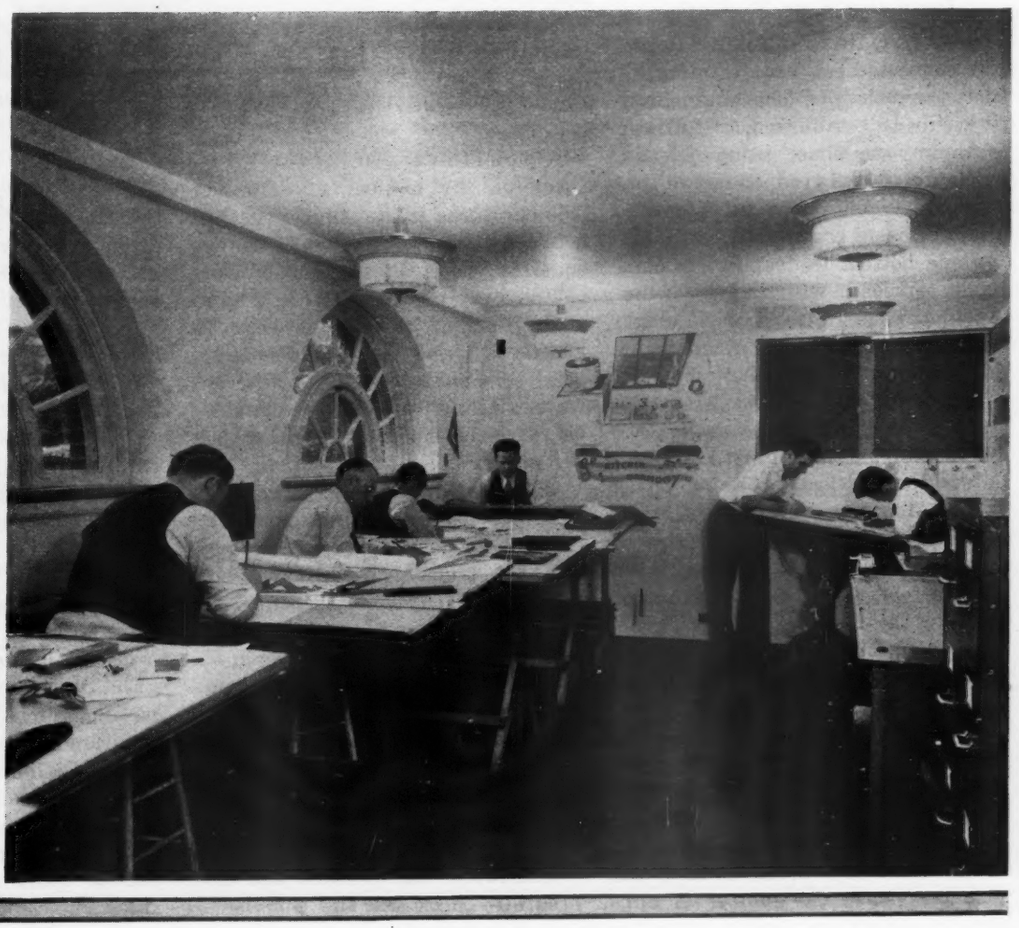
Some claim that their lamps will give a great deal more light than similarly rated lamps of better known brands. When such lamps are tested, they will be found to be mis-labeled. In an actual test of a batch of such lamps a short while ago, a lamp labeled 150 actually consumed 227 watts. Quite naturally it was brighter than 150-watt lamps of other brands, but it gave the user an erroneous idea of what he was paying for light. In addition it was not nearly so efficient in terms of lumen output as the better brands.

The manufacturers of good lamps have specially designed portable instruments to make comparative tests. If a purchaser of lamps is tempted, for the sake of a few dollars' saving on first cost, to try some brand for which fantastic claims are made, he can save money and avoid grief by calling in the local representative of a good lamp manufacturer, and having him make an analysis of the unknown lamp.

Look Out for Those Discounts

Fortunately, the range in price between the good lamp and the poor one is not great, and it should be kept in mind that economy in lamp buying invariably requires the purchase of the most efficient lamp regardless of the discount offered with the poor one.

Lighting for Drafting



No ordinary drafting room, the architectural planning department at General Electric Institute, Nela Park, Cleveland, hints at improvements, especially in the way of efficient and decorative lighting, that could be made in many a plant engineering department

A.C. Wave Windings

Four ways of connecting the leads, with simple rules for classifying according to number of slots per pole per phase

A. C. ROE

IN THE preceding article in the March issue, the basic features of the simplified a.c. wave winding diagrams that will be used in this series were described briefly. The method used to connect up the twelve leads of the three groups shown in Figure 1 of this article and in Figure 2 of the preceding article can now be described.

The winding shown in Figure 1 has four slots per pole per phase. All figure-8 connectors have been applied, leaving only the six top and six bottom single leads unconnected; therefore the winding is in condition to permit its use to illustrate a few simple and fundamental rules that apply to the simplified diagrams.

Identifying Wave Windings

Note, first, that by looking at any fully connected a.c. wave winding its "slot per pole per phase" identity can easily be established, as follows: Locate any one phase group of leads, which are always grouped in two bottoms and two tops, as in Figure 1. Observe that a phase group starts at a single bottom lead and ends on a single top lead, with two leads between. These two inner, single leads are always spaced a number of clips equal to one less than the slots per pole per phase away from the leads at each end of the group.

For example, in Figure 1, *C1* and *C4* are the end leads of the C-phase group. The inner leads are *C** and *C3*, and *C** is spaced three clips in from *C4*, whereas *C3* is spaced three clips in from *C1*. Hence, these clips indicate the number of short pitch (SP) connections.

With an even number of slots per pole per phase, as 2, 4, 6, and so on, the number of clips between *C1* and *C3* and *C** and *C4* will be the same, or the number of clips at *SP-1* or *SP-2* plus 1 equals the number of slots per pole per phase.

For an odd number of slots per pole per phase the number of clips at *SP-1* will be one more than the number of clips at *SP-2*. To find the slots per pole per phase add the number of clips at *SP-1* and *SP-2* together, add two and divide this total by two.

This rule also works for an even number of slots per pole per phase. For example, in Figure 1, *SP-1* and *SP-2* are 3 each; then $(3 + 3 + 2) \div 2 = 4$ slots per pole per phase.

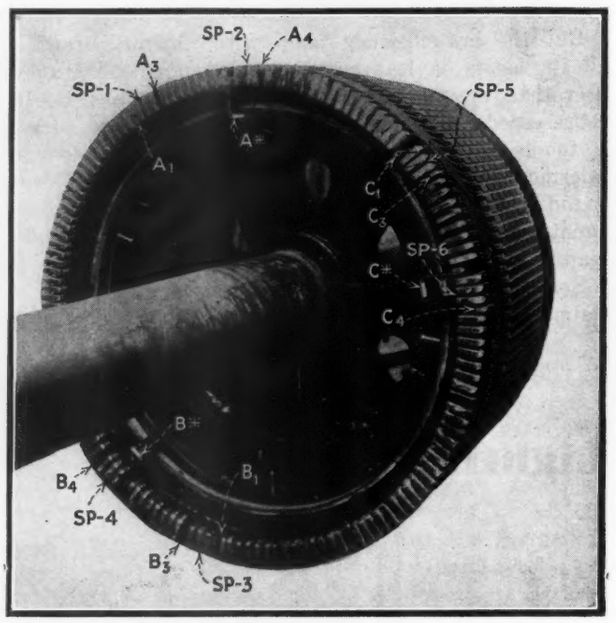


Figure 1. This winding has four slots per pole per phase. The six top and six bottom single leads have not been connected

A positive check on the number of slots per pole per phase is the number of clips between *C3* and *C**, which is always equal to twice the number of slots per pole per phase. Thus in Figure 1 the number of clips between *C3* and *C** is 8, and $8 \div 2 = 4$ slots per pole per phase. Hence, any a.c. wave winding can easily be classified as to the number of slots per pole per phase.

The foregoing rules hold good for windings having a single conductor per slot. The winding in Figure 1 has two straps in parallel, but both are in one clip and therefore are considered as one conductor per slot. For windings having more than one conductor per slot per coil section, divide the number of clips at *SP-1* or *SP-2* by the number of conductors per slot before adding; also, divide the number of clips between *C3* and *C4* by the number of conductors per slot, before dividing by two.

Therefore, the quickest and most accurate check on the number of slots per pole per phase is to locate the *C3* and *C** leads of any phase group and count the number of clips between these leads. Check the number of conductors per slot and multiply it by 2. Use this product to divide the number of clips between *C3* and *C** and the result will be the number of slots per pole per phase.

The foregoing rules should be carefully studied, with the aid of Figure 1, so that any winding can be quickly identified.

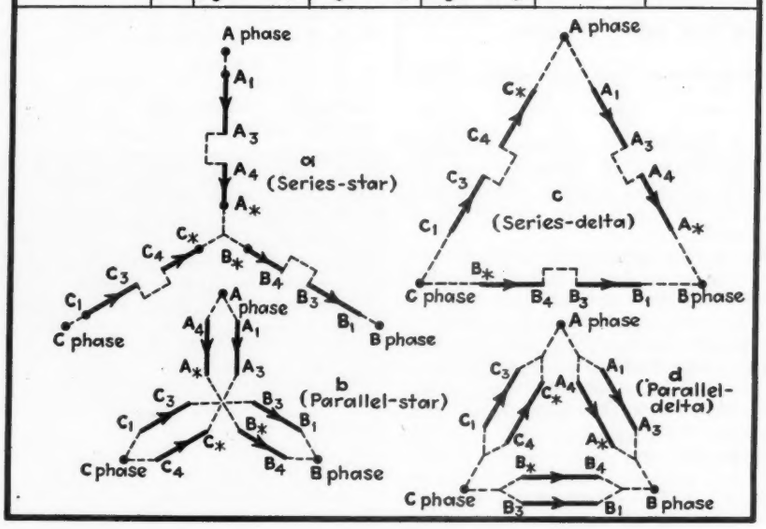
Possible Lead Connections

With the twelve leads of an a.c. wave winding four different connections can be made: series-star, diagram *a* (accompanying Table 1); parallel-star, diagram *b;* series-delta, diagram *c;* parallel-delta, diagram *d.*

Table 1 indicates how the winding leads are arranged to obtain any one of the four connections. In the first column the connection is given. The second column refers to the small diagram below showing the sche-

TABLE 1—LINE OR RING CONNECTIONS

CONNECTION	DIAGRAM	LINE CONNECTIONS			REVERSING JUMPERS	STAR RING CONNECTIONS
		A Phase	B Phase	C Phase		
Series-star	a	A_1	B_1	C_1	A_3 to A_4 B_3 to B_4 C_3 to C_4	A_*, B_*, C_*
Parallel-star	b	A_1 and A_4	B_1 and B_4	C_1 and C_4	none	A_*, B_*, C_* A_3, B_3, C_3
Series-delta	c	A_1 and C_*	B_1 and A_*	C_1 and B_*	A_3 to A_4 B_3 to B_4 C_3 to C_4	none
Parallel-delta	d	A_1 and A_4 C_3 and C_*	B_1 and B_4 A_3 and A_*	C_1 and C_4 B_3 and B_*	none	none



matic connection. Columns 3, 4, and 5, show which winding lead or leads should be connected to the line leads or slipring leads. The sixth column shows which line leads are to be connected together to form the reversing jumper that joins together the two sections of each phase (note that reversing jumpers are used only with a series connection. The seventh, last, column shows which winding leads are used to form the star ring or connections.

The small schematic diagrams, *a*, *b*, *c*, *d*, show how the two sections of each phase are connected according to Table I. Thus the *A1* and *A3*, *B1* and *B3*, *C1* and *C3* leads form the beginning and ending of one section, and the *A4* and *A**, *B4* and *B**, *C4* and *C**, leads are the beginning and ending of the second section. The short dotted lines connecting the sections together in diagrams *a* and *c* are the reversing jumpers.

The fact that all three-phase a.c. windings consist of six sections can be used to detect interconnection as follows: Consider the winding in the condition shown in Figure 1. To check whether the clips on the other coils have been placed correctly, hold a 110-volt test light on lead *A1* and touch all the other leads in turn. A light should be obtained only from leads *A1* and *A3*. With the test light held on leads *B1*, *C1*, *A4*, *B4*, and *C4* in succession, a light should show only between leads *B1* and *B3*, *C1* and *C3*, *A4* and *A**, *B4* and *B**, *C4* and *C**.

The small diagrams *a*, *b*, *c*, and *d* below Table 1 should be used as a guide for the line connections for all of the 13 connecting diagrams in this series.

Slot and Pole Combinations

Table 2 has a number of important features. The number of slots per pole per phase is given in the top horizontal line. Under each slot per pole per phase (SPP) rating is given the connecting diagram figure number, and the connecting table number for each diagram. The number of slots possible for each slot per pole per phase rating from 4 to 24 poles is given in the vertical columns.

In this table roman numbers have been used to identify both the connecting diagrams and the connecting tables used with each diagram; this method of distinguishing them makes possible a positive separation of the major items from other figures and tables.

The first column of Table 2 indicates the number of poles from 4 to 24 inclusive; after each pole number the horizontal line indicates the number of slots possible for a three-

(*Continued on advertising page 90*)

Table 2—Number of Slots per Pole for Various Slots per Pole per Phase Combinations

Number of Slots Per Pole Per Phase (SPP)

NO. OF POLES	2 Fig. I Table I	2½ Fig. II Table II	3 Fig. III Table III	3½ Fig. IV Table IV	4 Fig. V Table V	4½ Fig. VI Table VI	5 Fig. VII Table VII	5½ Fig. VIII Table VIII	6 Fig. IX Table IX	6½ Fig. X Table X	7 Fig. XI Table XI	7½ Fig. XII Table XII	8 Fig. XIII Table XIII
4.....	24	30	36	42	48	54	60	66	72	78	84	90	96
6.....	36	45	54	63	72	81	90	99	108	117	126	135	144
8.....	48	60	72	84	96	108	120	132	144	156	168	180	192
10.....	60	75	90	105	120	135	150	165	180	195	210	225	240
12.....	72	90	108	126	144	162	180	198	216	234	252	270	288
14.....	84	105	126	147	168	189	210	231	252	273	294	315	336
16.....	96	120	144	168	192	216	240	264	288	312	336	360	384
18.....	108	135	162	189	216	243	270	297	324	351	378	405	432
20.....	120	150	180	210	240	270	300	330	360	390	420	450	480
22.....	132	165	198	231	264	297	330	363	396	429	462	495	528
24.....	144	180	216	252	288	324	360	396	432	468	504	540	576

Questions *and* Answers

Conducted by G. A. VAN BRUNT

Combustion Control Instruments

I should like to have the opinion of readers as to how large a boiler plant must be, based, say, on the rated horsepower of the boilers, before the installation of such instruments as steam flow meters, CO_2 gages, flue temperature indicators, and so on, can be justified. That is, what must be the rating, as a rule, before the savings possible by the use of these instruments would probably pay a good return on the investment? Will you also give me in the order of their importance the three boiler plant instruments that are most valuable, or whose use is likely to lead to the largest savings?

L.O.K.—Cincinnati

IN MY opinion boiler horsepower is a poor yardstick by which to measure the amount to be expended on boiler instruments. To be sure, the size of a plant will give some indication of how elaborate a set of instruments would be reasonable, but size alone has little to do with the returns that can be expected. Boiler instruments are not of themselves producers of high efficiency; the story they tell must be analyzed intelligently by a capable operator and the necessary changes made. If this is not done, boiler instruments are a liability, not an asset.

If instruments are properly used few plants that need the continuous attention of an operator are too small to make desirable at least a draft gage and a flue gas analyzer of the hand type. If possible the draft gage should be of the multiple type. By analyzing the flue gas at regular intervals and manipulating the dampers to give the desired readings, at the same time observing the draft readings, one can soon become accustomed to firing by draft gage and do a very creditable job.

Usefulness of flowmeters increases as the number of boilers in parallel operation increases. With them the operator is able to divide the load properly. Flowmeter readings are a valuable addition to plant records, since they are a means of checking accurately the efficiency of the plant.

Flue gas thermometers are, I think, less valuable than any of the other instruments. However, if a record is kept of their readings one is able to detect dirty and scaled tubes, holes in the baffles, and so on.

There are all kinds of boiler instruments on the market, ranging from the rather inexpensive, simple individual and hand-operated types to the electrically operated variety. Instruments suitable for practically any plant are available.

From my experience with a very complete set of boiler instruments it is my belief that if they are carefully selected with regard to the needs of the plant, and perhaps the personnel, they can be made to return a profit on the investment. However, the amount of profit will depend upon the previous efficiency of the plant and how the instruments are used.

ROY M. STINSON
Operating Engineer
Rock Island Lines, Chicago

?

What are your most troublesome problems? Free-for-all discussion of them will help you and other readers

D.C. Generator Brushes

A 150-hp. d.c. generator is giving much trouble from constant chattering of the brushes. By putting a little paraffin on the commutator we can stop the noise for about an hour, but it always returns. The commutator has been turned down, but that did not help. Then the brush-holders were reversed so that the brushes point in the direction of rotation instead of against it, as formerly, but there was no improvement. Would the clearance distance between the brush-holders and the commutator affect the chattering in any way? How can I clear up this trouble? C.E.—San Diego

MANY brush and commutator troubles can be eliminated by properly performing the exacting operations of turning or grinding, stoning, slotting or undercutting, polishing, and cleaning.

The commutator bolts should be tightened while the machine is hot and before the above work is undertaken. In this way the following causes of trouble are eliminated: high and low bars; high mica; eccentric and rough commutator; flat spots; shorts between bars; dirty surface.

Other causes of brush troubles may be due to:

1. Brush tension being too light or excessive. Either may cause sparking, hot commutator, or chattering. As a rule brush tension should be about 2 lb. per square inch.
2. Armature out of balance.
3. Pounding of engine.
4. Low bearing.
5. Brushes not fitting holders properly. They may be set at the wrong angle, or may be too tight or too loose.
6. Brush-holders being too high from the commutator surface.
7. Hard spots on the commutator.

I suggest that C.E. examine his generator for these causes of trouble. The remedies are obvious.

JOSEPH A. SCHNEIDER
Steubenville, Ohio

Acidproof Paint for Steel Tanks

We are having trouble from the corrosion of steel tanks containing commercial stearic acid. What kind of paint or other coating can we put on the inside of these tanks to protect the metal?

M.E.—Kansas City

CORROSION of metals under conditions in which they should be unaffected is often most puzzling. Details of the working conditions in the plant are not given, but it is hoped that these suggestions on where to look for trouble will be helpful.

Examine all of the metal pipe connections and fastenings to the interior and exterior of the tanks, since it is possible that with the acid, or with impurities it may contain, electrochemical action is set up. In the electrochemical series of metals iron (steel) is low on the list, and in a solution with copper, lead, or tin, will be attacked first. Also, a small amount of free hydrogen may cause trouble. If metal fittings are the cause those in use at present should be changed to others with which electrochemical action is not so pronounced.

A question arises as to whether the acid is still or in motion. It is well known that some liquids, if motionless in a tank or pipe, will cause corrosion, whereas if they are in motion the container will not be affected. For example, 18-8 stainless steel (chromium 18, nickel 8, per cent) tanks containing still salt water will be attacked. Therefore, it is possible that if the stearic

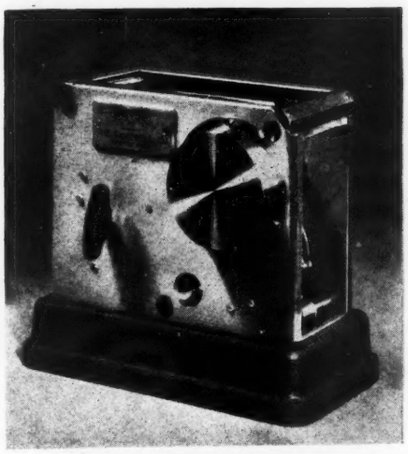
(*Continued on advertising page 94*)

EQUIPMENT NEWS

Telephone

Automatic. For private use. Ten-line capacity. Automatic switchboard mounted with battery eliminator which permits plugging into 110-volt, 60-cycle outlet. Also model using dry cells. Wall and hand phones equipped with ten-hole calling dial. Easy installation, fast connections claimed. Known as Type 34A16 P-A-X. Automatic Electric Company, 1033 W. Van Buren St., Chicago.

Relay



Selective. Operates in response to timed signal. Applicable to master fire alarm, pump controls, starting and stopping of machinery. Spring-driven mechanism. Open- or closed-circuit operation. Dimensions, $4\frac{3}{16}$ x $7\frac{7}{8}$ x $6\frac{9}{16}$ in. Inclosed with heavy bronze plates and plate glass panels. The Gamewell Co., Newton, Mass.

Cables

Two. One, for use in ducts, has lead sheath inclosing layers of cloth and asbestos treated with non-inflammable liquid of high dielectric strength. Other, for use in oily or alkaline locations, has rubber-compound insulation. Can be used in ducts or underground. General Electric Co., Schenectady, N. Y.

Switch

Type D, 30-amp. Base and operating mechanism mounted on metal supporting plate hinged to inside of box. By pulling operating handle entire interior swings out and away from box for convenience in wiring. When connections have been made, interior swings back into place and is secured by single setscrew. Positive-pressure fuse clips, fibre operating links, and arc suppressors are other features. Available in not-fusible, plug and cartridge fusible, straight 2-pole, 2-wire solid-neutral, and 3-wire solid-neutral, 125-250-volt and 250-volt, in 30-amp. sizes. Square D Co., Detroit.

Truck

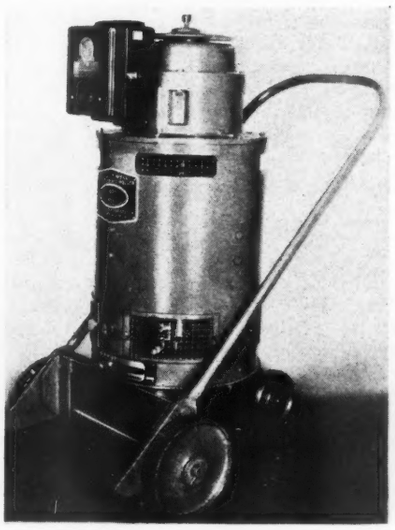
Hand-lift, 1,000-lb. capacity. Lightweight. Has reinforced steel plate welded between side rails so it can be used with or without skid platform. Will handle 36x47-in. platform in 4-ft. aisle. Single front caster wheel. Width, 18 in.; lift, 2 in. Called "Zephyr." Also new featherweight skid platforms (1,000-lb. capacity). Yale & Towne Mfg. Co., Philadelphia.

Electrode

Arc welding. Known as "Toolweld." Designed for restoring worn cutting edges and providing hard cutting edges on tools made of ordinary steel in place of high-speed steel. Deposits claimed to have a hardness of 55 to 65 Rockwell C, and to maintain it up to approximately 1,000 deg. F. Deposits can also be heat-treated in same manner as high-speed steel. Made in 14-in. lengths, four sizes: 3/32, $\frac{1}{8}$, 5/32, and 3/16 in. The Lincoln Electric Co., Cleveland.

Welder

P&H-Hansen 50-amp. vertical model, No. W50-254. High-speed arc welds down to 26-gage steel. Internal stabilizer winding stabilizes arc. Single adjustment dial. Motor, 3-hp. squirrel-cage, operates on any a.c. power line. Stationary or wheel mounting. Width, 15 in.; height, 36 in. Harnischfeger Corp., Milwaukee.



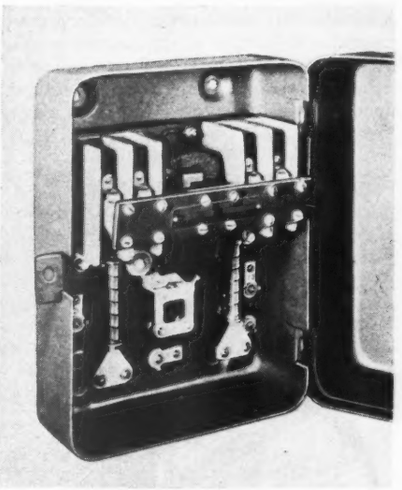
Grinder

Bench. Capacity, $\frac{1}{4}$ hp. Single-phase a.c., 110 and 220 volts; three-phase, 220 volts. Direct current, 115 and 230 volts. Size of wheels, 6x$\frac{3}{4}$ in. 3,500 r.p.m. Equipment, 2 grinding wheels, 2 guards, cord. The Hisey-Wolf Machine Co., Cincinnati.

Compressor

Steam, booster. Takes steam from existing boiler system, raises its pressure beyond capability of boiler itself, and distributes it to points of demand. Claimed to require little attention, maintain predetermined pressure or temperature within close limit. Worthington Pump & Machinery Corp., Harrison, N. J.

Starter



For a.c. squirrel-cage and slipring motors. Automatic reset overload; manual reset overload operated from button in cover. Thermal overload relay with adjustable rating. Housing of pressed steel for general use and cast iron for dust- and water-tight applications. Monitor Controller Co., 75 West St., New York.

Valve

Plug-type. For use where there is excessive wire drawing or erosive action. Seat and disk of nickel alloy; can be reground without removing valve from line. Seat ring renewable. Stuffing box can be repacked under pressure. The Fairbanks Co., 393 Lafayette St., New York.

Recorders

Two series. For recording draft, pressure, and temperature. Series "OT" designed for various ranges from 0 to 0.5 in. to 0 to 100 in. water. Dry-

type diaphragm. Need not be accurately leveled. Series "OH" for low ranges of differential pressure between 0 to 0.1 in. and 0 to 0.4 in. water. Spirit level built in for accurate leveling, needed since counterweight rather than spring opposes diaphragm movement. Both series equipped for wall or panel mounting. Dust-tight cases of cast iron and sheet steel. The Hays Corp., Michigan City, Ind.

Fan

Called "Ultra-Quiet, Styled Fan." Wall or bracket mountings. Oscillating. Three sizes. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis.

Washfountains

Circular. 54 in. diameter. Accommodate ten persons at one time. Bowls are solid, one-piece, 10-gage iron pressings with either apron or roll rim, finished in acid-resisting vitreous enamel. Pedestals of pressed iron base with welded superstructure, finished in either vitreous or synthetic enamel. Bradley Washfountain Co., Milwaukee.

Drill Stand

No. 7, bench. Converts portable electric drill to drill press. Four-to-one leverage on feed handle. Tool bracket can be raised or lowered and swung in arc. Accommodates 5/16-in. and ¼-in. special and heavy-duty drills. The Black & Decker Mfg. Co., Towson, Md.

Fixture

Lighting. Explosion-proof. For installation in Class I, Group D hazardous locations. Fixture parts claimed to withstand internal explosions without permitting escape of flame or hot gases. Glass cover designed to withstand hydrostatic pressure of 380 lb. per sq.in. Non-tarnishing aluminum alloy reflector. Easily serviced. Pendant-type removable hood for conduit attachment, or junction-box type for ceiling mounting. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Fire Pumps

Improved line. Type LG. Centrifugal, single-stage, volute. Electric motor, combustion engine, or turbine drive. Sizes, 500, 750, 1,000, 1,500 gal. per minute. Worthington Pump and Machinery Corp., Harrison, N. J.

Gaskets

Metallic and semi-metallic. Faces provided with ductile and resilient raised ribs, claimed to set into tight contact even on imperfect flange faces and under light bolt pressure. Made in solid copper, steel, iron, aluminum, or lead. Also available as a metal shell with asbestos filler. Circular, elliptical, or special forms. Goetze Gasket & Packing Co., New Brunswick, N. J.

Drill

Electric, portable, ¼-in., standard-duty. Over-all length, 12 in.; weight, 7¼ lb. Universal 110-120-volts, 25-60-cycle motor. No-load speed, 1,700 r.p.m. Housing of aluminum alloy. Bronze wool-packed bearings with thrust ball bearings on spindle shaft. Heat-treated alloy gears. Three-jaw chuck with key. Known as Type OB-4. Signal Electric Mfg. Co., Menominee, Mich.

Cleaning Tool

Removes rust, scale, and paint from steel in preparation for painting. Depth shoe regulates degree of impact of 72 cutters making 115,000 impacts per minute. Universal motor, ½ hp. Weight, 20 lb. Model M. "Berg" Cleaning Tool Division, The Concrete Surfacing Machinery Co., 4667-69 Spring Grove Ave., Cincinnati.

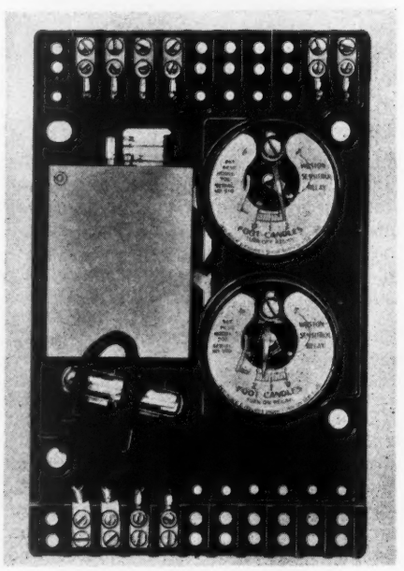
Pump

For pumping exact quantities of chemicals. Working parts of nickel semi-steel. Plungers and cylinders interchangeable from ½ to 3 in. diameter. Stroke adjustable from 0 to 3 in. Can be adapted to any type driving unit. Height, 23½ in. Weight, 125 lb. Dearborn Chemical Co., 310 S. Michigan Ave., Chicago.

Terminals

Conductor. Called "Wedge-On." Enough insulation is cut off to insert bare wire end into wedge which is then forced into barrel of lug by means of special plier-like tool. Sizes, No. 22-4 wire. The Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.

Illumination Controller



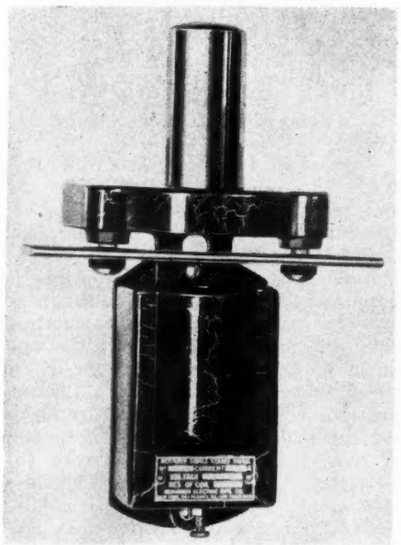
Photronic cell detects changes in light intensity below and above adequate illumination. Relay switches lights on and off as needed. Called Model 709 Illumination Control Relay. Western Electrical Instrument Corp., Newark, N. J.

Engine

Diesel. 100-150 hp. Six cylinder. Fuel pump and nozzle combined in injector unit placed in center of cylinder

head and surrounded by four valves. Oil received by injectors at less than 10-lb. pressure, injected into combustion chambers at 2,000-4,500 lb. No high-pressure fuel lines. Injector units actuated by two overhead camshafts. Gasoline starting. Water and oil pumps mounted directly on crankshaft which is of 4-in. diameter, statically and dynamically balanced. Murphy Diesel Co., Ltd., Milwaukee.

Bells and Chimes



Line of single-stroke bells and chimes for code calling and code warning. Adaptable for fire alarms. Solenoid-type mechanism with one moving part. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Truck

Hydraulic lift. Improved model. Three capacities, 3,500, 5,000 and 6,000 lb. Changes include: frame of angle-iron construction; roller bearings in front wheels; leak-proof air vent. Lyon Iron Works, Greene, N. Y.

Sockets

For 3-filament lamps. Mogul base assembly. For use with Benjamin 150- and 200-watt lamp and 200-watt lamp with three light-output stages. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Fire Extinguisher

Pressure type, 2-qt. capacity. Combination nozzle can be controlled to give fan-shaped spray or solid stream. Inner shell holds air under pressure, renewable at any air line having pressure of 100 lb. or more. Outer shell holds extinguishing fluid. Pyrene Mfg. Co., Newark, N. J.

Meter Panel

Cabinet-type. Three-point locking mechanism of rear doors prevents unauthorized access to connections. Self-supporting construction secured by bending sides of panel inward 90 deg. Drill holes in flanges permit bolting in place. Made of one-piece steel plate finished in slate black. Bailey Meter Co., Cleveland.

Gage

For testing vapor tension. Guaranteed accuracy ½ of 1 per cent of total scale. Correction for atmospheric conditions and temperature accomplished by adjustable dial which can be moved and set by two screws. All movable parts of cadmium-plated bronze. "Everdur" hair spring. Waterproofed. Foxboro Co., Foxboro, Mass.

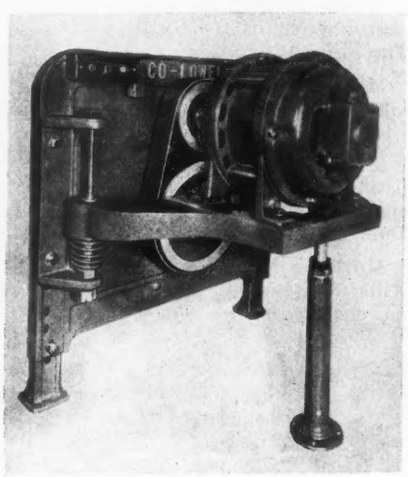
Respirator

For use in severe concentrations of wood, cement, asbestos, flour, cellulose, aluminum, and gypsum dusts. Uses filter pouch designed to give high filtering efficiency and low breathing resistance. Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn, N. Y.

Grinders

Portable, electric. Redesigned line, 4-, 5-, 6-in. units. New features include increased power, full-sized ball bearings on armature shaft and wheel spindle, inclosed commutator compartment, improved ventilation, and adjustable wheel guards. Universal motors; 110, 220, or 250 volts. The Van Dorn Electric Tool Co., Towson, Md.

Pivoted Motor Bases



Three designs for spinning frames. Floor and shelf types support motor 8 in. above floor. Vertical-drive type holds motor above driven pulley. Belt tension maintained by springs beneath motor shelf. Speed varied by changing pulley diameter. Reversible. Base acts as guard around drive. Rockwood Mfg. Co., Indianapolis.

Flow Meter

For liquids and gases. Isometer type. Constant-pressure drop maintained by changing orifice opening. Amount of flow determined by measuring amount of opening. Mechanical motion of actuator unit converted to electrical impulse which is transmitted to meter units at any point in plant. Elgin Softener Corp., Elgin, Ill.

Pump

For acid handling. Called "Ace Hard Rubber Centrifugal Pump." Hard-rubber casing and impeller claimed to be heat- and distortion-resisting and corrosion-proof. Suction, 2 in., discharge, 1½-in. diameter. Motor, 1 hp., 1,750 r.p.m. American Hard Rubber Co., 11 Mercer St., New York.

Sheave

Rubber-faced with wood lining. For use with wire cable. Manufacturer claims weather does not affect facing. Made of cast iron with facing in solid piece for small diameters, segments for large diameters. Diameters of 21, 30, and 48 in.; also special sizes. Anti-friction bushings. D. J. Murray Mfg. Co., Wausau, Wis.

Trolley

For portable tools. Eliminates use of long cables. Trolleys travel along buses contained in nearly closed, overhead duct. Tool cables are connected to trolleys. Duct will support at least five trolleys per 10-ft. section. Can also be used for supplying current to mobile machines. Called "Trolley-Square-Duct." Square D Co., Detroit.

TRADE LITERATURE

AIRBRUSHES—Bulletin A1-35, covering line of airbrushes.—Paasche Airbrush Co., 1909 Diversey Parkway, Chicago.

AIR FILTER—Bulletins No. F-310-2 and F-320-3, describing filters for air compressors, internal combustion engines, motor intakes, general ventilation. — Coppus Engineering Corp., Worcester, Mass.

AIR NOZZLES — Pamphlet F533-A, describing line of air nozzles with renewable non-metallic disk. — The Lunkenheimer Co., Cincinnati.

BAFFLES—Bulletin, describing Beco-Turner Baffles. — Plibrico Jointless Fire-Brick Co., 1800 Block on Kingsbury St., Chicago. (The Plibrico Co. will install these baffles in the future, succeeding the Boiler Engineering Co. of Newark, N. J. which has discontinued business.)

BELTING — Bulletin, "Industrial News." No. 2, showing V-belt drives. —The Gates Rubber Co., Denver, Col.

BELTING—Booklet, title "Vim Short-Center Drive With Vim Tred Leather Belting."—E. F. Houghton & Co., 240 W. Somerset St., Philadelphia.

BUCKET ELEVATORS — Catalog No. 565, covering line of bucket elevators. —The Jeffrey Manufacturing Co., Columbus, Ohio.

CANADIAN MARKET—Booklet showing distribution of Canada's purchasing power. — Toronto Industrial Commission, Toronto, Canada.

CEMENTED CARBIDE — Catalog Supplement SC-35, title "The Profitable Use of Carboloy." Also booklet, "Complete Information on the Profitable Use of Carboloy Tools."—Carboloy Co., Inc., 2985 E. Jefferson Ave., Detroit.

CENTRIFUGAL PUMPS — Four Bulletins: W-310-B4A, on types C, CA, and CB; W-318-B4, on three-stage volute, type UC; W-320-B1, on single-stage volute, type LG; W-321-B3, on Monobloc. — Worthington Pump and Machinery Corp., Harrison, N. J.

CHAIN DRIVES—Book No. 1425, shows installations and uses of silent-chain drives.—Link-Belt Co., 910 S. Michigan Ave., Chicago.

CHAINS—Catalog K-1, showing line of chains and sprockets, and giving engineering data for chain users.—Baldwin - Duckworth Chain Corp., Springfield, Mass.

CIRCUIT BREAKERS — Bulletin GEA-1662A on trip-free air circuit breakers. —General Electric Co., Schenectady, N. Y.

CLEANING EQUIPMENT — Catalog A182, title "Remove the Dust Menace," describing vacuum cleaning equiment. —U. S. Hoffman Machinery Corp., 105 Fourth Ave., New York.

CLEANING TOOL—Leaflet, announcing Model M electric cleaning tool.—"Berg" Cleaning Tool Division, The Concrete Surfacing Machinery Co., 4667-69 Spring Grove Ave., Cincinnati.

CONCRETE — Bulletin, "Pozzolith for More Permanent Concrete." — The Master Builders Co., Cleveland.

CONDENSERS — Manual and catalog, presenting data on electrolytic and oil-filled condensers.—Aerovox Corp., 70 Washington St., Brooklyn, N. Y.

CONTROLLERS—Folder, describing instruments for recording and controlling boiler operation and plant processes.—The Brown Instrument Co., Philadelphia.

CONTROLLERS AND PYROMETERS — Folder, describing "Tag" controllers and pyrometers.—C. J. Tagliabue Mfg. Co., Park and Nostrand Ave., Brooklyn, N. Y.

CONVEYORS — Catalog showing conveyor units.—The Lamson Co., Syracuse, N. Y.

DRAWN STEEL—Pamphlet announcing facilities for heat- and cold-treating steel bars.—Union Drawn Steel Co., Massilon, Ohio.

ENAMEL — Booklet, title "At Your Service," describing field service to users of enamel.—Ferro Enamel Corp., Cleveland.

FAN — Folder S438, announcing quiet fan.—Wagner Electric Corp., St. Louis.

GEARS—Catalog No. 56-G, containing listings, weights, and dimensions of gears, sprockets, and chain. — The Medart Company, Potomac & DeKalb St., St. Louis.

HOLYOKE, MASS.—Brochure describing industrial advantages of Holyoke, Mass. — Holyoke Water Power Co., Holyoke, Mass.

LEATHER PACKINGS — Bulletin A49, describing leather packings.—Alexander Bros., 406 N. Third St., Philadelphia.

LIGHTING—"Six-Point Program for the Effective Lighting of Industrial Plants."—Benjamin Electric Mfg. Co., Des Plaines, Ill.

LUBRICATION — Booklets (4), on lubrication problems; "The Lubrication Engineer—His Value to You," "The Lubrication of Diesel Air Compressors," "Diesel Engine Bearing Lubrication," and "The Lubrication of Beaters and Jordans."—The Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago.

MALLETS—Folder, covering line of mallets and mauls. — Lignum-Vitae Woodturning Co., 96-100 Boyd Ave., Jersey City, N. J.

METER—Folder, describing universal recording meter for measuring fluids.—The Foxboro Co., Foxboro, Mass.

METERS — Catalog GEA-612B, showing line of demand meters.—General Electric Co., Schenectady, N. Y.

MILL SUPPLIES — Catalog No. 16, listing mill supplies and contractors' specialties.—Greene, Tweed & Co., 109 Duane St., New York.

MOTORS—Magazine, title "The Louis Allis Messenger," containing articles on electric motors.—The Louis Allis Co., Milwaukee.

OILING DEVICES—Catalog No. 50, describing complete line of oil cups, oil seals, grease cups, and other lubricating devices.—Gits Bros. Mfg. Co., 1846-62 S. Kilbourn Ave., Chicago.

PNEUMATIC TOOLS — Bulletin SP-1876, title "Power Vane Rotary Tools," describing drills, grinders, wrenches, woodborers, and concrete surfacers.—Chicago Pneumatic Tool Co., 6 E. 44th St., New York.

TESTING INSTRUMENTS—Catalog No. 1400, describing principles of operation of "Megger" insulation-testing instruments.—James G. Biddle Co., 1211-13 Arch St., Philadelphia.

STRIP STEEL—Booklet, title "Batting 'em Out," describing hot- and cold-rolled strip steel. — Acme Steel Co., 2840 Archer Ave., Chicago.

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Books

HIGH-LEVEL CONSUMPTION
Its Behavior; Its Consequences

William H. Lough, president, Trade-Ways, Inc., and Martin R. Gainsbrugh. McGraw-Hill Book Co., Inc., 330 West 42d Street, New York. 336 pages, 27 charts, index, appendixes. $4.

Based on estimates of consumer's purchases from 1909 to 1931, this book provides means of (1) calculating potential markets for commodities and services; (2) deciding what goods are likely to prove most salable; (3) appraising obsolescence caused by shifting demands; (4) judging the extent of over-capacity in an industry; (5) choosing investments in expansible lines of business; (6) answering other questions of planning and strategy.

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EXECUTIVE GUIDANCE OF INDUSTRIAL RELATIONS

Dr. C. Canby Balderston, Research and Industry departments, Wharton School of Finance and Commerce, University of Pennsylvania. University of Pennsylvania Press, Philadelphia. 435 pages, including index, appendixes. $3.75.

An analysis of the experience of twenty-five companies. Details of the company programs, factors underlying personnel decisions, a selected composite program, and an appraisal of methods and conflicting concepts. Appendixes give a tentative employment code, guiding principles for voluntary unemployment reserves and pension plans, and a check list of personnel standards.

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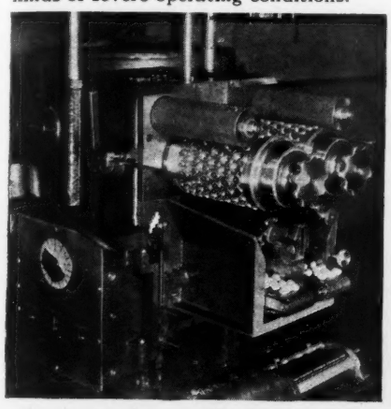
Capitalism Carries On

Walter B. Pitkin, author of "Life Begins at Forty." Whittlesey House, McGraw-Hill Book Co., Inc., 330 W. 42d Street, New York. 282 pages. $1.75.

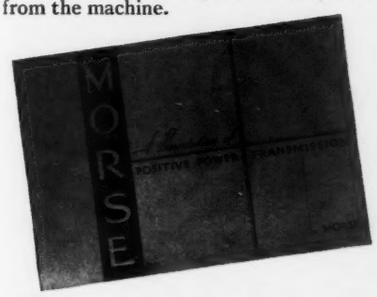
A defense of capitalism. The author believes the future of the system is greater than its past, believes an immense amount of pioneering remains to be done in the fields of low-cost production of goods, new aids, comforts, and services for better living.

POWER TRANSMISSION NEWS

A large Metropolitan police department after exhaustive tests selected Morse Roller chains as standard motorcycle chains. Their experience shows that Morse Roller Chains stand up better and longer than any other . . . a tribute to their quality and stamina. These chains are subject to all kinds of severe operating conditions.



An interesting application of Morse 3/16" pitch chain is illustrated in the above picture. This machine makes and fills gelatine capsules, the 3/16" chain is used as a carrier for the capsules as they come from the machine.

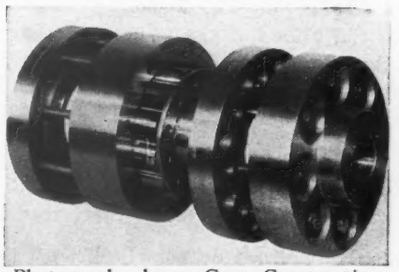


Morse has recently produced a large sized portfolio illustrating many applications of chain drives. This book is available to power transmission users. Ask the Morse Chain Company, Ithaca, New York for a copy of this new book.

Morse roller chains are finding many varied uses in industry. Here they are driving a mixing tank in the laboratory of a large enamel and lacquer manufacturing factory. Improved design, better materials and ample provision for lubrication mean longer and more satisfactory service.

The Morse Improved Kelpo free-wheeling clutch is now offered in three different types . . Morflex . . Ratchet . . and Back Stop. This new Morse designed clutch embodies the use of solid accurately ground alloy steel cams. Each cam is independently sprung for rapid and accurate engagement. Driving pinion on all models is ball bearing mounted, self lubricated with adequate leather and felt oil seals.

The Morse Improved Kelpo line comprises eight different sizes, rated in capacity from ⅛ h.p. at 100 r.p.m. to 12 h.p. at 100 r.p.m.



Photograph shows Cam Construction, Morflex type

Chain Drives
FOR modern precision machine tools, Morse Chains provide a uniform flow of power at constant speed from the driving motors to all moving parts, combining all the good characteristics of all forms of drives and assuring maximum production.
Chain drives are flexible, non-slipping, economical and adaptable to any transmission requirement.
ALWAYS USE CHAIN DRIVES
MORSE CHAIN COMPANY
DIVISION OF BORG-WARNER CORPORATION
ITHACA · NEW YORK

ADVERTISEMENT—*Each item on this page is a paid advertisement*

Check Those Flow Meters

(Continued from editorial page 170)

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as determined by the formula:

$$\text{Differential head (in inches of water)} = \frac{\text{Chart reading (squared)}}{\text{Max. chart reading (squared)}} \times \text{Head (in inches of water) for max. chart reading}$$

If readings do not check with the differentials as determined by the formula, the meter should be recalibrated or adjusted.

A water-column calibration outfit that can be made up from parts out of any factory stockroom, is illustrated in Figure 1 and consists essentially of a scale, two ½-in. glass tubes, two short rubber tubes, two ⅜-in. tees, two ¼-in. petcocks.

Making the Calibration Test

After filling the outfit with water, and before starting the test, care must be taken to work all air bubbles out of the fittings and the testing equipment. The outfit is operated by pouring water into the high-pressure connection through the long glass tube and by manipulating the equalizing valve in the meter and the petcocks on both the high- and low-pressure connections until the desired chart readings are obtained with zero water level in the low-pressure connection. The head, *H*, may then be directly determined by reading the scale.

Once properly installed, the primary element, which may be an orifice, flow nozzle, or venturi tube, should require little or no maintenance. However, if trouble develops, it is well to be sure that the primary element (if an orifice or flow nozzle) is properly centered in the pipe line and that any gaskets used in connection with it do not obstruct the flow through the primary element.

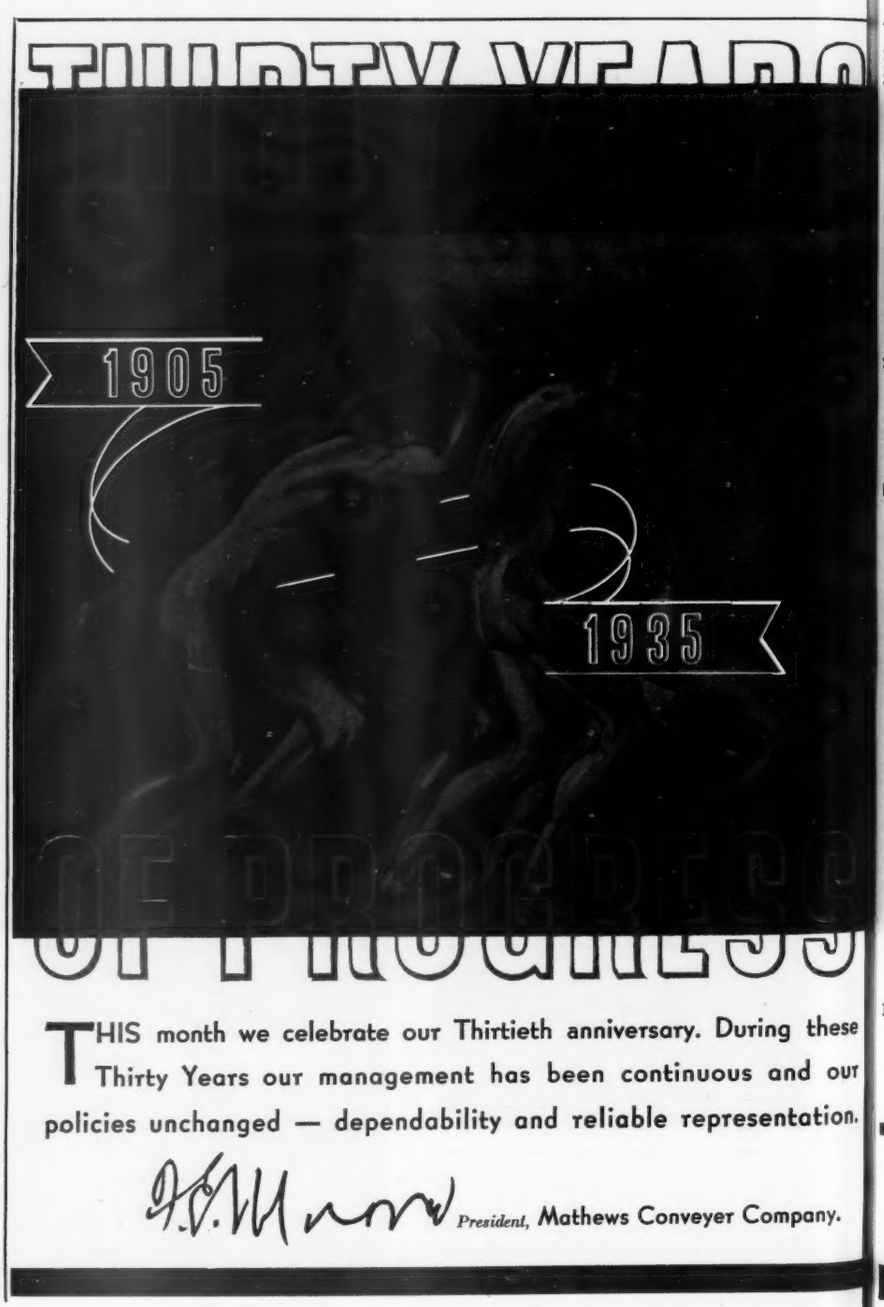
Such obstructions change the effective size of the opening and render the meter inaccurate. The pressure taps made at the inlet and outlet of the primary element must be finished off smooth without burrs on the inside of the pipe line, and care must be taken that the nipples screwed into these connections do not protrude into the main line.

Periodic inspection and blowdown of the connecting piping between primary and secondary elements should be a part of the maintenance routine. In the measurement of steam it is highly important that the condensate reservoirs installed at the orifice be level with each other since any deviation from a horizontal plane results in the application of a false differential head on the meter flow mechanism.

And Then the Connecting Pipes

While it is possible to use brass or wrought-iron pipe to connect the primary and secondary elements, experience has shown that the ideal material is extra-heavy soft-annealed or half-hard copper tubing and compression fittings. A steam flow meter installed with this material is illustrated in Figure 2. It will be noted that a minimum of fittings is used, bends being made in the tubing itself rather than by the use of fittings—thus reducing the possibility of leaks.

Compression fittings are used to join lengths of copper tubing and to connect the copper tubing to iron-pipe thread connections at the reservoirs and at the meter. In installing copper tubing it is best to make the run from the primary element to the meter with one length of tubing if possible, thereby elimi-



THIS month we celebrate our Thirtieth anniversary. During these Thirty Years our management has been continuous and our policies unchanged — dependability and reliable representation.

President, Mathews Conveyer Company.

nating a joint and the excellent possibility of subsequent leakage.

If the tubing to the valves at the meter becomes hot, it is likely that there is a leak somewhere in the system. The meter should be shut off immediately for repairs.

Settling Chambers

Connecting lines should be blown down regularly. If there is a tendency to collect considerable dirt, it is advisable to install settling chambers as illustrated in Figure 3. These chambers can be made up from iron-pipe fittings. When properly installed (see Figure 2), they are of great assistance in keeping sediment and other foreign material out of the flow meter mechanism.

When inspecting connecting piping it should be borne in mind that the two lines (high-pressure and low-pressure) should be run close together and kept out of contact with hot steampipes as the temperature resulting from such contact is likely to produce unequal densities in the two lines. If connecting lines are exposed to low temperatures, they should be covered.

Under all conditions the copper tubing should be supported to prevent sagging and to maintain a grade of 1 inch per foot. Across open spaces the tubing should be supported on angle or channel iron. A neat installation may also be effected by running tubing in conduits when such conduits are properly graded. To prevent trouble from trapped air, all connecting lines should grade toward the meter at least 1 inch per foot. If it is necessary to install the orifice below the meter, risers with air cocks must be placed at the top of all vertical runs so that any accumulation of air can be easily released.

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Every Worker Has Ideas

(Continued from editorial page 148)

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man, he has slight chance of getting any more ideas from the same man, or from others who hear about it, and such news travels fast.

He knows that he cannot run his department without the aid of those under him, and that if he himself wants promotion, he must encourage his men to think, or his department will stand still. If his department stands still, he will stand still. If he stands still, someone under him is likely to pass him, for there are live ones in every department, who persist in being found. So he might just as well get credit for finding them.

Poor Ideas Die Natural Deaths

He will help the man work up his suggestion, perhaps asking the methods or time study department to aid in getting the facts and showing the possible savings. In the very act of making such an investigation, suggestions that are not justified die a natural death, or better ones are evolved.

Thus most of the impractical ideas never reach those who must render a decision, and instead of taking a callous attitude toward suggestions, management feels that if they are submitted they are worth careful consideration. Proof of this lies in the exceptionally high percentage of adoption in plants where such a suggestion program has been conducted.

To summarize, then, management must indicate an open-minded attitude toward constructive changes. A complacent attitude of manage-

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HOW MILLIONS OF OPERATIONS ARE BUILT-IN

C-H 9586 "AAA" Starters for 7½ h. p., 440 volts—5 h. p., 220 volts —and smaller motors

IN most plants the total horsepower of motors up to 7½ h. p. exceeds that of larger motors. Here lies the greatest opportunity for gaining the benefits of Motor Control, the link between fallible humans and their machines. C-H "AAA" starters will fully realize that benefit in any plant.

COMPARE the "AAA", as C-H does in keeping it ahead! KNOW that here is value, in terms of millions of operations!

Note that C-H uses contacts "shod," not plated, with solid silver. Unlike other metals, silver whether bright or oxidized is a perfect conductor —no oxide here that will "freeze" contacts together. In the "AAA", contact troubles are not STOPPED because *they do not* START.

Note that these contacts are twin-break, cutting heat rise, and snuffing out the remaining tiny arc in deep Thermoplax pockets. Note the simple "AAA" switching mechanism. It is designed with the same basic magnet structure as C-H heavy duty steel mill controls. It is so built because so far nothing more sure and certain has been developed. Not in laboratories but in daily, monthly, yearly operation C-H "AAA" starters prove C-H Motor Control Leadership with millions of operations.

Read the features opposite, an exclusive "AAA" combination. They tell why so many plants will buy no others, and why you should. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1310 St. Paul Avenue, Milwaukee, Wis.

These Proven Features Recommend Exclusive Use of C-H 9586 "AAA" Starters

1. Heavy silver twin-break contacts render oxidation harmless. Operate on severest inching service at maximum h. p. Carry rated current with less than half permissible temperature rise.
2. Deep non-removable Thermoplax contact-pockets "soak-up" arc. No shields to misplace, no fragile parts. Contacts easily renewed, coils are readily changed. Only needed tool is screwdriver.
3. Twin-break contacts halve arc voltage.
4. C-H Overload Relay provides absolute protection . . . maximum production. Changes for current-rating and type of motor made simply by changing heater coil.
5. Designed to prevent contacts closing due to jarring, etc., until starter-button is pushed.
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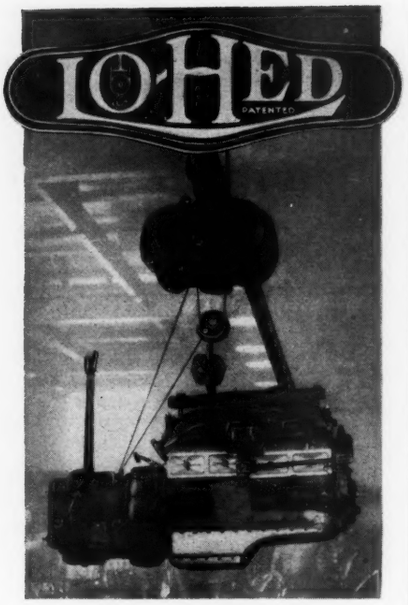
8. Minimum of current-carrying joints. Low contact resistance. Low voltage drop.
9. Stocked by responsible independent electrical wholesalers everywhere.

CUTLER HAMMER MOTOR CONTROL

Starts, Stops, Regulates, Protects Industry's Motors



30 to 50 Lifts per day for 7 years—*and*

NOT ONE CENT FOR REPAIRS

That's the history of a **Lo-Hed** Hoist purchased by the Autocar Co., Ardmore, Pa., in 1928.

Engines lifted weigh from twelve to fifteen hundred pounds.

Aside from lubrication and a periodic inspection and tightening-up of nuts and screws this hoist has required no attention—no maintenance of any kind.

No wonder "Autocar" says "we prefer **Lo-Hed** Hoists!"

You, too, can reduce *your* hoist and hoisting costs—specify **Lo-Hed** when you buy hoists. Let us send the bulletins.

AMERICAN ENGINEERING COMPANY
PHILADELPHIA

Autocar

ment toward the existing order of things, and an opposition to change is bound to be reflected all the way down the line. Realization that the top man in the organization wants the cooperation of his assistants and working force in solving problems is the best stimulus to enthusiasm.

The foreman must not only convince his men that he wants their ideas, but he must also have enough training in analyzing every operation in his department to enable him to enlist the aid of every employee in suggesting better methods. He must overcome the suspicion of the workers by showing them that he will see that every suggestor receives proper credit.

Prompt Attention

Facilities must be assured to give prompt attention to suggestions. Each one should be acknowledged immediately, preferably by personal visit. If the information is not complete, help may be given in securing all the facts. The man making the suggestion should be informed from time to time of its progress.

Proper publicity given to suggestions is most effective. The plant paper offers a good medium. In some plants where a motion economy program is in effect, a special bulletin is issued monthly. This describes the suggestion, tells of the savings or other improvement, and gives due credit to the man or men making the suggestion.

Such a bulletin serves several purposes. It is often more effective than a cash award, as any employee is proud to see his name thus cited. Ideas may be passed from one department to another, even to entirely different operation. A spurt of friendly rivalry between various departments may stimulate all to even further efforts.

It has long been recognized that a successful suggestion system is a valuable aid to management in the improvement of manufacturing methods, product, safety, and the morale of the whole organization. It is also a valuable aid to the foreman who takes the right attitude toward it. If properly handled, it recognizes the creative instincts of the workers and enlists their cooperation not only in doing new things, but in doing their daily tasks well. It makes every employee feel that he is a partner in the business,

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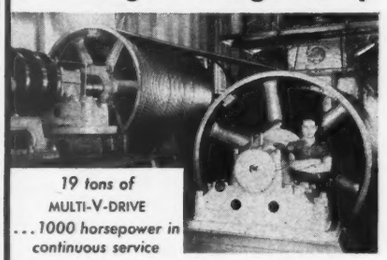
54 GOODYEAR EMERALD CORD BELTS

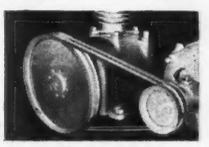
driven by

Worthington Diesel Engine, Speeds Giant Worthington Centrifugal Dredge Pump



19 tons of MULTI-V-DRIVE *... 1000 horsepower in continuous service*

THIS is one of the largest V-belt drives in the world. It demonstrates the practicability of high efficiency Multi-V-Drives on heavy-duty machinery, such as ball, rod and tube mills, heavy saw mill and paper mill machinery, crushers, etc. . . . and on many others of every class where even, maximum power is required.



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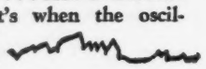
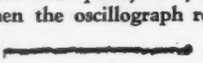
WHAT EVERY WELDING OPERATOR SHOULD KNOW...

ABOUT UNIFORM HEAT

Current fluctuations in your arc welder mean uneven heat . . . irregular penetration . . . variations in metal fusion . . . lack of uniform strength. That's when the oscillograph record looks like this: 
It's uniform heat that determines the strength and quality of your welds. When the oscillograph record looks like this: 
the welds will be of uniform penetration and density. And they'll be uniform from one weld to another.

That's why P&H-Hansen puts so much emphasis on uniform heat delivery at the arc . . . why the stable arc characteristic is "built in" — not artificially produced by separate stabilizers. Study the P&H-Hansen features. Ask for the 24-page Bulletin "Weld It Well".

HARNISCHFEGER CORPORATION
4525 W. National Ave., Milwaukee, Wis.

P&H HANSEN ARC WELDERS

as he can succeed and progress only as his company succeeds and progresses.

Properly encouraged, workers have always indicated their desire to have a part in such progress, by submitting ideas. The one thing that is needed, then, is training in properly expressing such ideas, and in a systematic approach to the problem of subjecting every single operation in the plant to the questions, WHY, WHAT, HOW, WHO. WHEN and WHERE.

•

In Paralleling D.C. Generators

(Continued from editorial page 171)

•

directly with the load. Usually the series field winding is provided with an adjustable shunt so that some of the armature current may be diverted from the series field winding. By varying the amount of current shunted, the full-load voltage may be varied over a considerable range. Therefore, adjustment of the shunt field so that each machine has the same no-load voltage and the series field shunt so that each machine has the same full-load voltage is the first step in securing successful parallel operation.

Negative Lead Resistance

When two engine-driven generators of approximately the same speed and rating are to be paralleled, the voltages at loads other than no load and full load are very nearly the same, so it should not be necessary to make changes in the design of the machines in order to operate them in parallel. If a slow-speed, engine-driven generator having a 5 or 6 per cent hump in voltage at one-third to one-half load is being paralleled with a high-speed turbine-driven generator, it may be necessary to make major changes in the design of the machines before satisfactory parallel operation can be obtained. In no case, however, should these changes be considered until test has shown that they will not parallel satisfactorily without changes.

The second requirement of satisfactory load division is that each negative lead resistance—the resistance including the series field with

THERE'S EXTRA PROTECTION FOR YOU IN MOTOR CONVERTIBILITY

With the new P&H Convertibles you can change an open type motor into enclosed fan-cooled, splash-proof or totally enclosed construction.

For the manufacturer of motor powered equipment it means easy adaptation and more prompt deliveries on special requirements. For the user it means easy correction of misapplications, extra protection against complete motor replacement, avoidance of costly delay that ties up production—yet there's no extra cost for the advantages of convertibility.

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Your machines can meet today's speeded-up production schedules, if you modernize your lubrication program.

Men responsible for production and maintenance are looking for better oils and greases to meet today's requirements. The tough-film Sta-Put Lubricants were developed to do this job. They combine the highest film strength, leak resistance, and maximum lubricating properties, to last longer, cost less, and reduce wear. To be specific about Sta-Put—

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"300" STA-PUT SERIES. . .

A complete range of lubricants to take the place of light, medium and heavy red engine oils or machinery oils of all weights.

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Five grades considerably heavier than the No. 300 Series, used for general industrial lubrication, to meet the requirements of certain heavy duty machinery.

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A range of greases which are definite colloidal compounds. They do not dry out, become rancid or develop free fatty acid. They will not separate in use or in storage.

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Extreme Pressure Gear Oils having the greatest load-carrying capacity ever obtained in a lubricant without the use of lead or other abrasive material. They withstand from three to as much as ten times the load of untreated mineral oils of the same type and save power.

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Established in 1865

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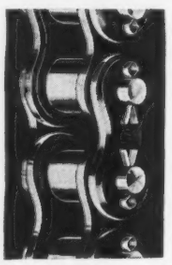
A QUALITY PRODUCT
rides on a Quality Chain



The huge Crawford traveling ovens in which Bond Bread is baked use Baldwin-Duckworth machine finish roller chain exclusively. *Users* know. The best argument for Baldwin-Duckworth chains and sprockets is the type of concerns who use them.

Send for our complete catalog of power transmission, elevating and conveying chains and sprockets. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

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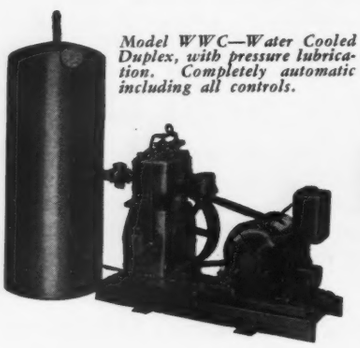

Model WWC—Water Cooled Duplex, with pressure lubrication. Completely automatic including all controls.

Model WWD—Water Cooled Duplex, with pressure lubrication. Any type control.

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Built to give the service you need to earn a profit—Quincy Compressors make a direct appeal where low-cost dependable air power is a production item . . . Years of efficient trouble-free service are the result of real engineering design and construction—including Timken Bearings, Pressure Lubrication, Automotive-type Pistons, Lynite Connecting Rods . . . Send for Bulletin and Engineering Data covering the complete Quincy Line of Air Compressors for Industrial Service.

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shunt plus the lead from the series field to the negative bus—be inversely proportional to the capacity of the machine. In addition, the equalizer connected to each machine between the commutating pole winding and the series field winding should be of low resistance. An equalizer as short as possible and having the same copper section as the main leads will be found satisfactory.

The equalizer parallels the series field windings of the two machines, thus making them stable for parallel operation. If the speed of the prime mover for No. 1 machine were slightly increased, the voltage of that machine would also be increased, and it would tend to take more load. Without an equalizer connection the voltage of machine No. 2 would decrease when some of its load was taken by the other machine, and as a final result No. 1 machine would be carrying all the load and driving No. 2 as a motor.

Negative Lead Resistance

With the equalizer connection, however, the voltage of machine No. 2 would remain the same, since its series field strength would be practically unchanged. Machine No. 1 would carry the extra load until its speed returned to normal.

Importance of having the negative lead resistance inversely proportional to the rating of each machine can be readily understood by reference to Figure 3, which shows two duplicate machines connected in parallel. If the negative lead resistance of machine *A* including the series field were twice that of machine *B* by reason of its much greater distance from the switchboard, the series field of machine *B* would be twice as strong as that of machine *A*, with the result that neither would be carrying its share of the load.

The third requirement of satisfactory load division is that the machines be in good operating condition. If machines that have been properly adjusted for voltage regulation and properly wired to the switchboard will not divide the load proportionately, faulty wiring is a likely cause. Loose or oxidized series field connections, series field shunt connections, commutating pole connection, or short-circuited or grounded field coils should be looked

Famous Moments in American Industry

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NEW BATTERY SAVES 16.6%

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THIS new patented battery offers average savings up to 16.6% without sacrificing life or performance. Instead, the exclusive Kathanode construction provides unequalled service throughout the entire guaranteed life of the battery.

Over fourteen years of research and development have preceded the introduction of this *modern* battery, for *modern* battery applications. Thus you can be sure of the extra efficiency and dependability of the Gould Armored Kathanode Construction.

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New type sling is easier to handle —SPEEDS UP LOADING*

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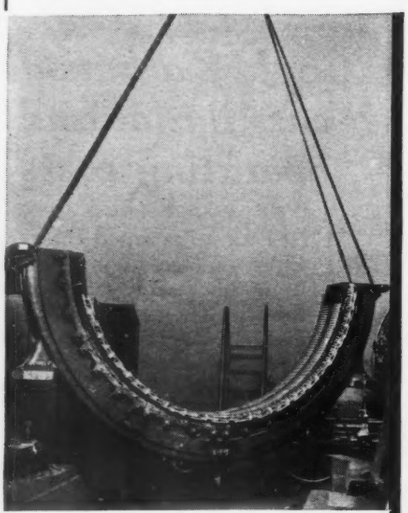

Multiple-part Macwhyte Drew Sling handling large burnt-out generator. These heavy-duty, flexible slings are giving excellent service for a well-known power plant.

*DREW Slings are made of one length of "Monarch Whyte Strand" wire rope—*spliced endless and then braided to give a flat, flexible body.*

This patented construction speeds up loading and gives an unusually high safety factor. DREW Slings do not kink and spin like ordinary wire rope slings. And they give longer service, too.

Custom built for all kinds of loads requiring a flat lifting element. Write for catalog and complete information.

MACWHYTE COMPANY, Kenosha, Wis.

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MACWHYTE WIRE ROPE *Slings*

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for. The diesel engine governor should be checked.

Any additional resistance in the series field circuit of either machine caused by loose connections or contact heating will upset parallel operation, but may have no appreciable effect on the machine when it is operated alone. If the diesel engine has 5 per cent speed regulation from no load to full load at one time and 10 per cent five minutes later, the machines cannot be expected to parallel.

Shifting the Brushes

If parallel operation of two machines is not considered quite satisfactory, it may be improved occasionally by shifting the brushes either with or against the direction of rotation. The direction of shift is best determined by trial. It should be kept in mind that any shifting of brushes changes the compounding or series field effect, and that after shifting a change may be required in the series field shunt.

If a change in brush position is found to modify the shape of the voltage regulation curve sufficiently to give better load division the commutation over the working range should be checked before a final setting is made. It is not advisable to sacrifice good commutation for good parallel operation. The shape of the voltage regulation curve can also be changed by notching the main poles, by increasing the main pole airgap, or by machining the tips of the main poles. These changes, however, can be made only at considerable expense as well as delay, since new material and design work are necessary. The manufacturer should be consulted before such changes are made.

The compensated type of generator has a voltage regulation curve that varies only a few volts from a straight line between no load and full load. The degree of success with which any two or more machines can be paralleled is largely a function of their voltage regulation curves. Duplicate d.c. machines should be expected to divide the load within 10 or 20 per cent of their rated capacity when both are at the same operating temperature. A slow-speed, engine-type machine can be expected to divide the total load equally with a high-speed, compensated type of machine only at no load and at the other

Idle Time of Machinery!

Do you know EXACTLY how much on each machine ?

A—Didn't get started until 9 A. M.
B—Stop of 40 minutes—waiting for material.
C—A hearty lunch!
D—Three 10-minute stops—machine jammed, poor material.
E—Operative left machine for half an hour. Why?
F—Plenty of time to wash up! Quitting time not until 5:00.

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See how "time down" stands out on the chart above. You can't miss it. You can't help but reduce it!

Suppose you could reduce idle time on all your factory machinery nearly 10 minutes a day! What would it amount to in a year—or even a month! More than you'll ever save by "little economies."

This little "time clock for machinery," the *Servis Recorder,* bolts or clamps right on to the machine itself—no ink, no pencils, no electric wires. Send for folder, "A Busy Plant."

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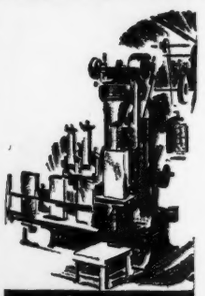
THE SERVIS RECORDER
The "Time Clock" for Machinery



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Pyroil has to its credit an unimpeachable record of the curing of innumerable operation ills due to friction troubles. Has solved many problems formerly considered insurmountable.

Pyroil not only cures frictional difficulties. It constantly safeguards equipment against many common damage dangers. Reduces fire hazards. Let us send you some facts which we are sure will prove interesting to you. Just mail the coupon. Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Pres., 646 LaFollette Ave., LaCrosse, Wis., U. S. A.

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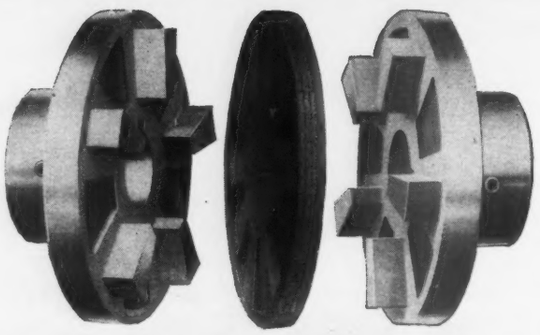
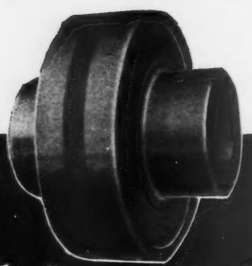


FLEXIBLE COUPLINGS



Absorbs Destructive Strains Like a Sponge Absorbs Water

WHEN direct-connecting your motor to its load, the simple precaution of using Wood's Flexible Couplings will save you many dollars in repairs and add years of life to your equipment.

These couplings protect both ends of your equipment—the motor and the machinery it drives by absorbing the destructive vibration set up by the intermittently loaded machinery and the resulting power surges of the motor.

Note the construction of Wood's Flexible Couplings shown above, consisting of two cast iron flanges with lugs cast integral and a multi-ply specially constructed leather disc.

It is this disc that absorbs all the punishment saving your motor and machinery all wear and tear.

T. B. WOOD'S SONS CO.
CHAMBERSBURG, PA.
30 Church St., New York City 387-391 Atlantic Ave., Boston
MEMBER: The Mechanical Power Engineering Associates

Only in Wood's Flexible Couplings do you get Wood's dependability.

load at which the regulation curves cross.

Parallel operation can, therefore, be said to be satisfactory if the machines are dividing the load as fairly as their types of design will permit. When machines are inherently difficult to parallel, some compromise such as a proportionate division of the load at full load on each machine and a somewhat unequally proportionate division of the load on each machine at partial loads is considered satisfactory.

•

A.C. Wave Windings

(Continued from editorial page 179)

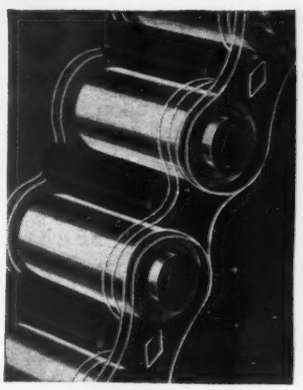
phase wave winding, up to eight slots per pole per phase.

It should be noted that Table 2 can also be used to check possible changes in the number of poles for a change in speed or frequency. For example, the table shows that 96 slots can be used for a 16-pole, 2 slots per pole per phase (2 SPP) winding; for an 8-pole, 4-SPP; and for a 4-pole, 8-SPP winding. Likewise, 120 slots can be used for a 16-pole, 2½-SPP, a 10-pole, 4-SPP, and an 8-pole, 5-SPP winding.

Checking Slots Against Poles

As a further check on a given number of slots for a desired number of poles, divide the number of slots by the total number of pole-phase groups (3 times the number of poles); the quotient should be either a whole number, as 2, 3, 4, and so on, or a whole number and a half, as 2½, 3½, 4½. For example, assume that it is desired to use 168 slots for a 28-pole winding. Then, $168 \div 84 = 2$ slots per pole per phase, which means that the connecting diagram in Figure 1 (to be given in a succeeding article) should be used, and from the checking chart which will be given with each connecting diagram, the connecting Table I can be filled in. Hence these charts and tables will permit the extension or addition of slot and pole combinations with very little effort.

(In the next article, which will appear in an early issue, a connecting diagram with its connecting table and checking chart will be given and the method of using them explained. —Ed.)



True accuracy of all parts—mirror-like finished hardened rollers, pins and bushings—rolling at every point of contact—virtually a series of roller bearings: reasons for the higher maintained efficiencies of Diamond Roller Chains.

WHEN THE MORNING WHISTLES BLOW

....INDUSTRY'S WASTES BEGIN

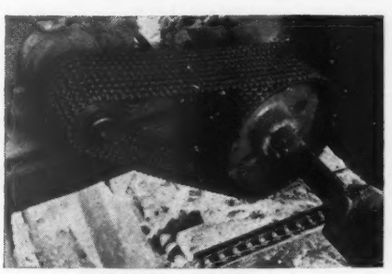
When industry's motors whir into action, power wastes begin. This is not because motors and machines are inefficient, but because power is lost between motor and machine.

Friction eats power. Anti-friction bearings have radically reduced such wastes on both motors and machines. It is left for Diamond Roller Chain Drives which roll at every point of contact, to apply this higher efficiency to transmission of power from motor to machine.

Modern Diamond Roller Chain saves power—carrying the load with smooth, frictionless effort. That is why more and more manufacturers have been steadily replacing their drives with Diamond—the roller bearing path for power.

Whether your plant has 10 motors or 10,000 the savings will rapidly pay the cost. And to this you add longer service and a positively non-slipping drive.

Diamond Roller Chain Drives are available in every part of the U. S. Make one installation—and you will understand why we say—"Higher efficiency Diamond Drives save power". DIAMOND CHAIN & MFG. CO., 449 Kentucky Ave., Indianapolis, Ind. *Offices & Distributors in All Principal Cities.*

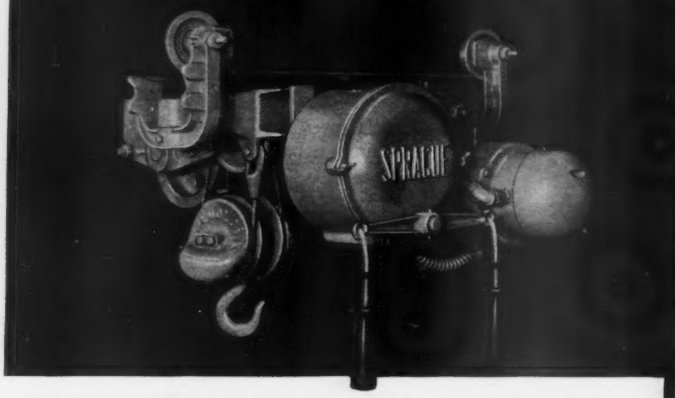


Diamond Roller Chain is made in a wide range of pitches and in single and multiple strands—the illustration shows an 8-strand drive from 50 h.p. motor, 1160 r.p.m., on 27-inch centers.

DIAMOND ROLLER CHAIN

ROLLING AT EVERY POINT OF CONTACT

SPRAGUE ELECTRIC HOISTS



CLOSE HEADROOM TYPE, ¼ TO 2 TONS

Features: 1. Absolute minimum of headroom consistent with safe, durable construction. 2. Direct worm drive. 3. Few moving parts. 4. Totally enclosed. 5. Automatic lubrication. 6. Noiseless operation. 7. Rope or push button control. 8. Anti-friction bearings. 9. Ball bearing trolleys with swivel yokes permit hoist to negotiate curves of small radius. 10. Hoist frame supported by trolley yokes and not suspended from king pin.

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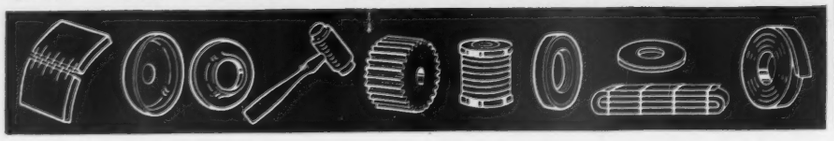

What Electron Tubes Are Doing

(Continued from editorial page 174)

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tube. The stable, high-vacuum photo-tube is used with an amplifier that controls the direct current furnished by a full-wave rectifier tube. A calibration curve of temperature against milliamperes shows that the readings are large for a small change in temperature.

Extremely quick action in response to light change is secured by substituting a Thyratron tube for the magnetic relay. Any magnetic device requires 1/30 second or so to pick up or drop out, and the time is not consistent. A Thyratron tube will pass direct current within 0.0001 second after the impulse.

Cutting Cement Sacks

This characteristic is used in register control where designs are printed on or woven into material in a continuous web, instead of on cut sheets. Cuts must be made between the designs, with only a small tolerance of creep.

For example, on the material from which cement sacks are cut a mark ⅛ inch wide is printed between designs. Between the feed rolls and the cutter of the machine a scanning head—a light source and a photo-electric relay—is located. With the sheet passing at 600 feet per minute the tube "sees" the dark mark for only 0.001 second. The impulse passed in this short dark interval is stopped by a synchronous switch mechanically driven from the cutter roll, provided the cut comes on the next mark ahead. If the cut comes ahead of or behind the mark, the switch provides a path for the impulse to go to one or the other of two Thyratron tubes.

As will be seen from the diagrams, the output of the active tube actuates devices that re-position the sheet and change the feed roll speed to avoid too frequent resets. At 200 cuts per minute the tolerance would be used up in 7½ seconds if the error amounted to 1 in 7,200, which is 0.005 inch in the length of a sack. Under good operating conditions the unit does not change the register oftener than every two minutes or so.

THE PURE OIL COMPANY, U.S.A.

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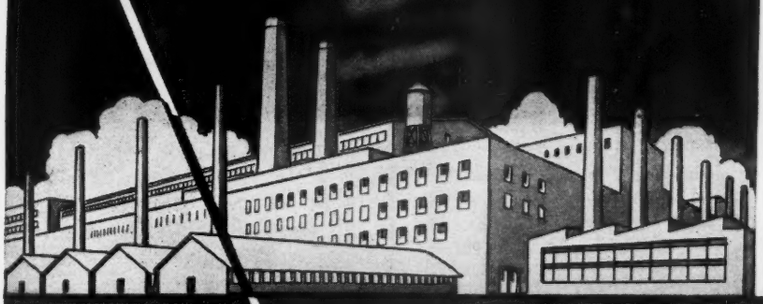
1 Pure Oil Crude comes from many types of oil fields in nine states. Some types of Crude are better adapted to certain uses than are others. Pure Oil, having a wide selection of Crudes, can better serve you by specifying the lubricant refined from the correct type of Crude for your particular lubrication need.

2 Good refining is vital. All types of Crudes must be correctly refined to prevent loss of inherent lubricating values. Pure Oil's modern refining methods, especially adapted to each type of Crude, preserve and improve the lubricating qualities of Pure Oil superior Crudes.

3 Scientific application is equally important. Good Crudes properly refined go for naught unless skilled engineering selects the types of lubricant best adapted to your particular problems. Pure Oil Engineers are thoroughly familiar with lubrication, its requirements, and its problems.

—Consult a Pure Oil Industrial Engineer for Practical Means of *Decreasing* Lubrication Costs and *Increasing* Lubrication Safety.



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U. S. A.

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SAVE ALL KINDS OF TROUBLE

Industry took the paint people's save-the-surface slogan seriously and saved millions of dollars. Now apply it to the factory or warehouse floor. Save your flooring surface and you save hundreds of miles of floor truck wear—save hundreds of minutes of delay—hundreds of foot pounds of wasted energy.

Save all this with Service Casters on your trucks—Service Trucks on your Service Casters. They are designed for swift, smooth materials handling—not a lumbering floor-pounding drag. The finest bearings perform the miracle of dissipating the lag of friction. Wheels of Textolite (a G. E. Product) ease the action further at the point of floor contact. Result: The casters spare the floors and in compensation the smooth floor spares the casters. A vicious circle of expense ended. Write us for floor saving facts and figures—and caster data. Service Caster & Truck Co., 505 N. Albion St., Albion, Mich.

Service ForgeWeld Caster
Drop Forged Steel
Pack-Hardened anchored ball race-way
Chrome steel load and thrust bearings
Hyatt roller bearing wheel
Alemite-Zerk lubrication

SERVICE CASTERS TRUCKS

for replacement and, for an all-'round fresh start—Service

Questions and Answers

(Continued from editorial page 180)

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acid were given a slight motion by an agitator, or even by fill and overflow, the corrosion would be stopped.

Application of paints, lacquers, and other protective coatings to a steel that is already eaten away is more or less of a makeshift. Before application the surface of the steel, also pipe lines, should be thoroughly cleaned and the protective coating carefully applied. Even then, although the coating may be resistant to the acid it may not adhere to the steel, which would then be attacked again.

Before making any changes that run into much money their cost should be compared to that of new tanks made of a material that is guaranteed to withstand the conditions. If the tanks are badly corroded it is possible that it will be cheaper to put in new tanks, instead of trying to patch up the old, corroded ones, which in any event will have to be replaced sooner or later.

CHARLES H. HUGHES
New Dorp, S. I., N. Y.

Methods of Cleaning Motors

I wish that readers would tell me what materials and methods they have found most suitable from the standpoint of efficiency, fire hazard, cost, and so on, for cleaning motors out in the plant, and in the repair shop. The coils of some of our motors get quite oily and dirty; others are exposed to a starch-like dust that becomes sticky when wet and dries to a hard crust. Water will slowly dissolve this crust, but I have been afraid to use it. Is it ever advisable to clean motors, or their windings with water? H.N.R.—Minneapolis

WE HAVE a large number of 440-volt, a.c. motors ranging from ¼ to 125 hp., and some 250-volt d.c. machines. Many of these motors get filled with sugar dust, some with syrup vapors, until all air ducts are closed. Others become choked with black dust and oil.

When there is time to bake the motors dry we wash the a.c. motors with a hose and hot water, using about 30 lb. pressure. After this treatment they are dried in a galvanized iron box arranged to give free circulation of air. Heat is provided by strip heaters and lamps, and a temperature of 90 to 100 degrees C. is maintained. Drying is continued until an insulation resistance test to ground with 250 volts direct current gives a satisfactory reading.

If a motor can not be spared long enough to be baked out we clean the windings of small motors with carbon tetrachloride forced out of a 1-gallon fire extinguisher at about 100 lb. pres-

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PROMPT SERVICE

We make gears for a large clientele—all types of gears in all metals and all "silent" gear materials — accurate, sound, smooth-running, quiet gears that give satisfactory service.

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